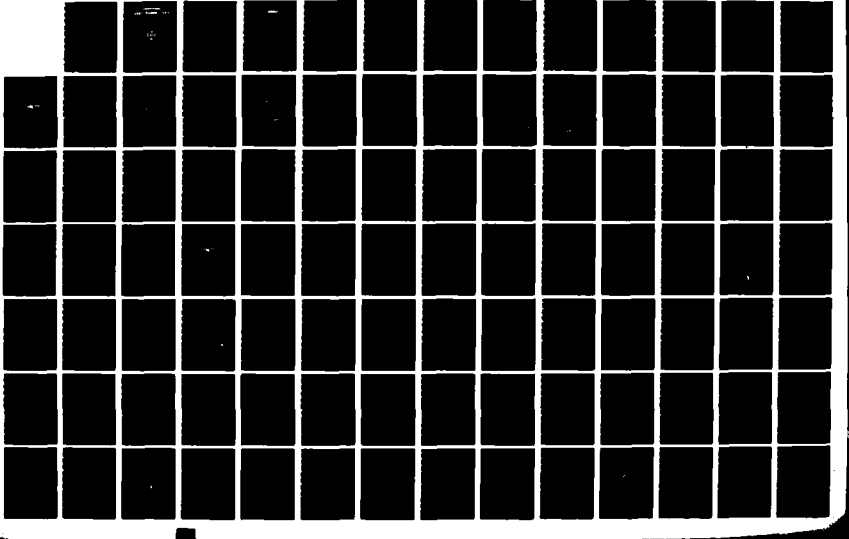
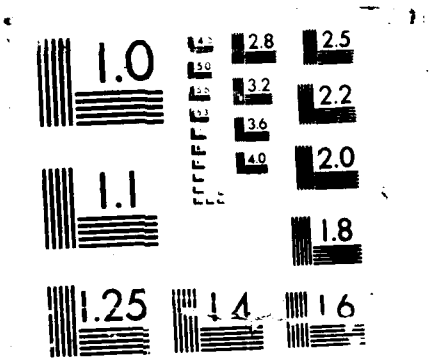
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BATTALION TRAINING MODEL SUMMARY

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The Army Training Study (ARTS Study) Group conducted a comprehensive overview of Army training. The research probed across a wide range of training issues as the study group sought a broad perspective of army training. The study group conducted field surveys at numerous continental US Army posts and schools. The data obtained was analyzed using the Training Effectiveness Analysis (TEA).

The Battalion Training Model Summary volume describe and explain the Battalion Training Model (BTM) and its uses. The BTM is a computer modeled analysis tool developed by the study group. It analyzes training resources available and predicts training levels attainable with those resources.

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BATTALION TRAINING MODEL

SUMMARY

The views, opinions, and/or findings contained herein are those of the Army Training Study Group and should not be construed as an official Department of the Army or US Army Training and Doctrine Command (TRADOC) position, policy, or decision unless so designated by other official documentation.

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BATTALION TRAINING MODEL

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Preface

This volume explains the concepts, organization, and functions of the Battalion Training Model (BTM). Chapter I discusses the purpose, scope, general description, and concept of operation of the model. Chapter II provides a specific description of each section of the model, laying out parameters, definitions, simplifying assumptions, equations, values, data and data voids. Chapter III presents a more technical description, discussing automatic data processing issues, program format, and operations research systems analysis (ORSA) logic. Chapter IV discusses the sensitivity analyses of the data as well as possible policy implications for the Department of the Army and HQ TRADOC. Chapter V presents conclusions and recommendations, in both administrative and substantive areas. Quality levels describing data used to support analyses and conclusions are outlined in Annex R.

CHAPTER I

INTRODUCTION

Purpose

The purpose of the Battalion Training Model (BTM) is to provide an analytical tool to respond to the guidance of the ARTS Study Directive and Study Advisory Group guidance as established in the TRADOC Commander's Memorandum of 27 February 1978, "Additional ARTS Guidance." This guidance directed that the Study Group precisely define individual and collective unit training requirements, factoring in their maximum feasible integration (i.e., training in more than one task concurrently). It further directed that the training frequency of these tasks be specified and that training proficiency be determined as a function of frequency and personnel turbulence. Finally, the Study Group was directed to develop a training hierarchy which relates resources, requirements, and training frequency to levels of readiness. Implicit were the tasks of linking readiness to mission/ARTEP/SM tasks (requirements) and determining the people, time, dollar, and resources necessary for training proficiency. Also implied was the requirement to consider the time required for nontraining activities and its impact on readiness. One means to address this guidance is to simulate the training environment of a typical Army unit. The BTM is such a simulation.

A battalion commander exists in an extremely complex environment. His goals and responsibilities are incommensurable and sometimes conflicting. Not only must he insure that the battalion and its subordinate units maintain an adequate level of training proficiency, but he must also see to it that his individual soldiers learn and retain proficiency in their combat skills and --a subtle difference-- achieve suitable SQT scores for career advancement. Administratively, the commander must create an efficient, smooth-running unit, with equipment kept in a proper state of maintenance and garrison support commitments met. In addition to these basic readiness requirements, the battalion must be responsive to such requirements as Reserve Component support, parades, obligations to soldiers (recruiting contracts for educational opportunities) and similar requirements, all of which compete for the unit's very limited resources: time, people, operating money, facilities, and equipment. Within this environment, the battalion must be kept ready for combat. A fully combat ready unit is one which could accomplish its missions on the "95% battlefield" with no additional training--one which is ready to go to war tomorrow. This is termed the Bn-1 unit. Other readiness conditions can be expressed as training days required to achieve Bn-1 status. For example, a Bn-5 unit requires 5 days of training to achieve fully combat ready status.

The Battalion Training Model uses the goal programming approach to describe and analyze this complex environment. It addresses each of the facets of the battalion's responsibilities by incorporating their interlocking mathematical relationships into a realistic simulation. Using the goal-programming variation of the Simplex algorithm, the model seeks the optimal allocation of the scarce resources to achieve the commander's goals. Because of the multigoal features of the algorithm, the model is able to determine the best method of allocating all resources and achieving the greatest portion of the battalion's objectives, as prioritized by the commander.

Scope

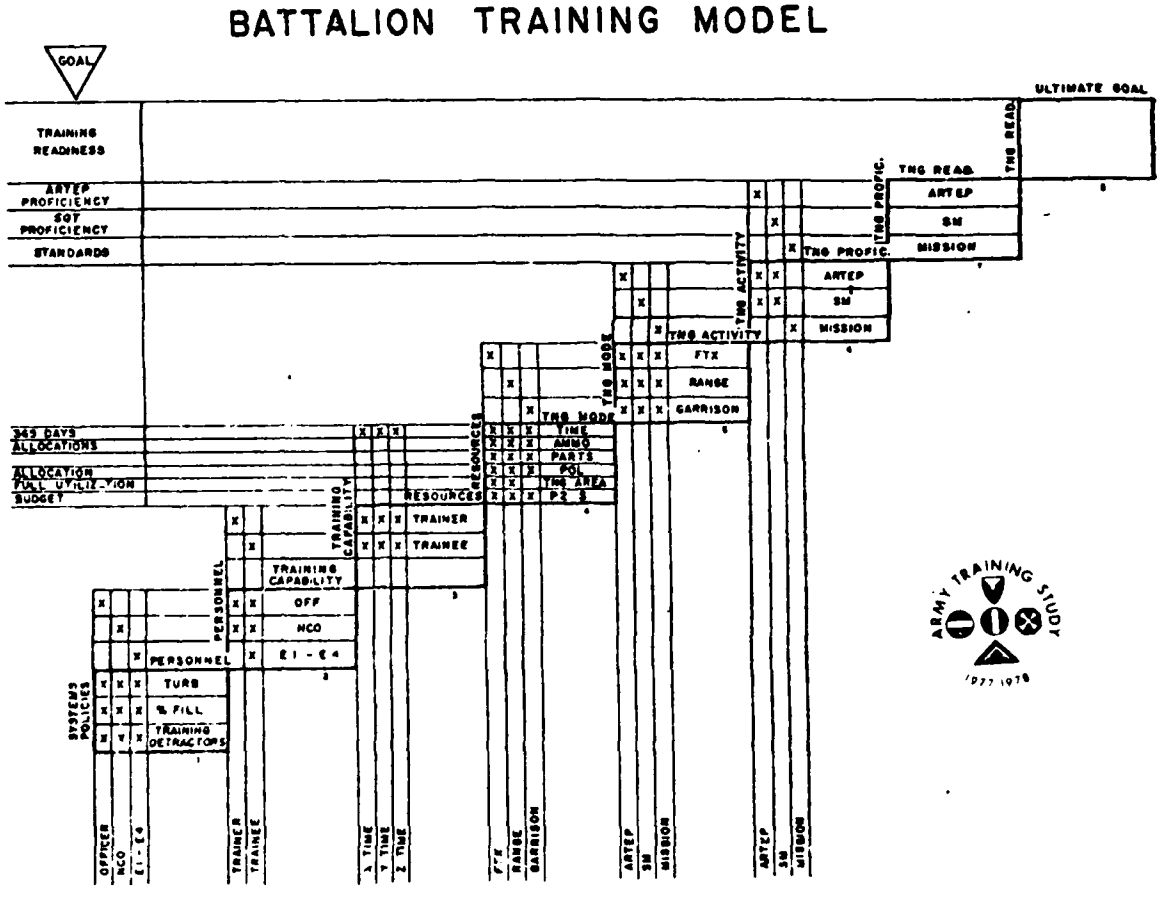
The scope of the requirement and the nature of the analytical technique dictated that the BTM be configured for use in a very sophisticated computer. Once refined and validated, the model should be a useful tool, not only in analyzing types of issues reflected in the guidance provided ARTS but also for many other policy issues relating to training resources and training readiness as well. Significantly, the BTM will also help battalion/company commanders formulate training programs and define the resources required to support them. Follow-on automatic data processing (ADP) efforts should be conducted to reduce the complexity of the current model so that it can be made compatible with the IBM 5100 computers presently scheduled for issue to some FORSCOM units in the fall of 1978.

The BTM training program is based on TC 21-5-7 (Training Management in Battalions), while the resource section is an expansion of the FORSCOM Training Management Control System (TMCS). Due to the complex nature of the program and the press of time, the prototype has been limited to addressing Active Component Mechanized Infantry/Armor battalion-sized training programs. With refinements, it will accommodate other combat and combat support battalions, Reserve Component use, and a subsequent aggregation of resource requirements to the DA level. Furthermore, it is compatible with zero-based budgeting concepts.

While defining training requirements to allow credible resource justifications, the BTM does not compromise local command prerogatives by making these requirements mandatory once resources are approved and programmed. The training program is merely a common sense approach prepared by seasoned commanders to help insure that units reach required training readiness. Providing the commander reaches this level of readiness within allocated resources, he may choose whatever program he desires based upon his estimates and diagnostic evaluation.

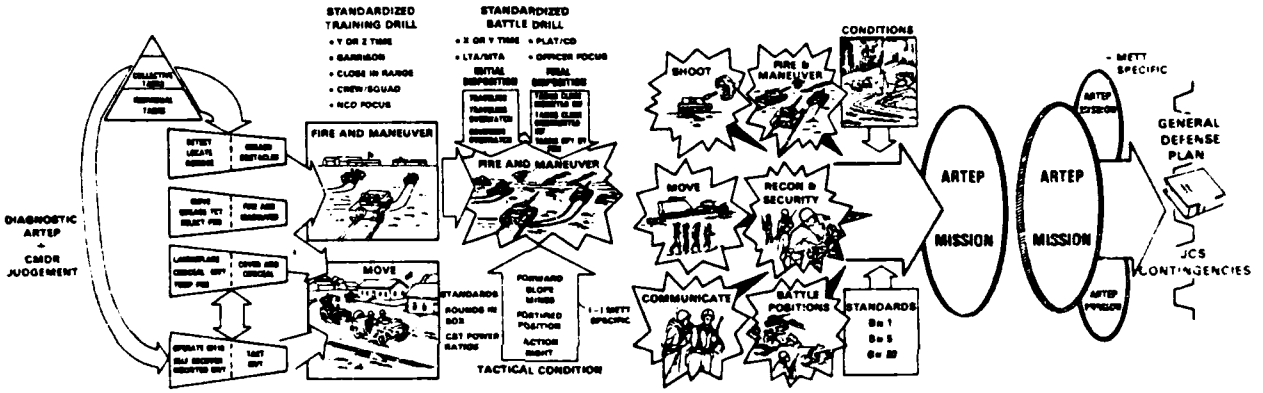
The BTM computer program parallels the ARTS model, tracing people, time, and dollar resources through training programs to training proficiency and readiness. The program does not address personnel leadership (PL_R), tactical readiness (TAC_R), logistical (LOG_R), or personnel readiness (PER_R) and thus does not pursue the ARTS model through combat effectiveness (see Training Proficiency, Readiness and Combat Effectiveness concept paper).

General Description



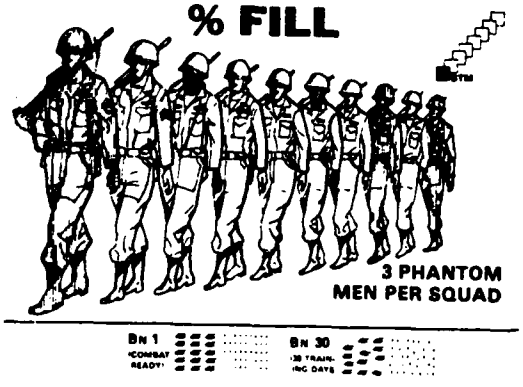
The general construct of the BTM is shown above. (A foldout of the above BTM schematic is at ANNEX A). Beginning in the lower left hand corner, blocks 1, 2, and 3 represent people resources; blocks 4 and 5 consider time and dollar resources; block 6 refers to training programs; block 7, to training proficiency; and block 8, to training readiness.

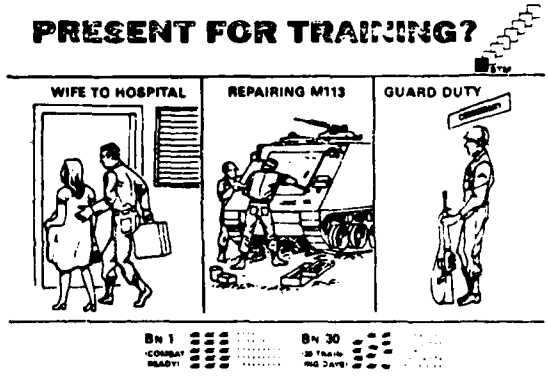
Block 1 of the BTM is the mechanism whereby such things as turbulence (changes in duty position), officer/NCO fill (trainer grade substitution), and other training distractors are introduced and related to training programs, proficiency and readiness.



Turbulence affects a unit by breaking up crews and teams. This engenders requirements for additional training to rebuild the disrupted crew.

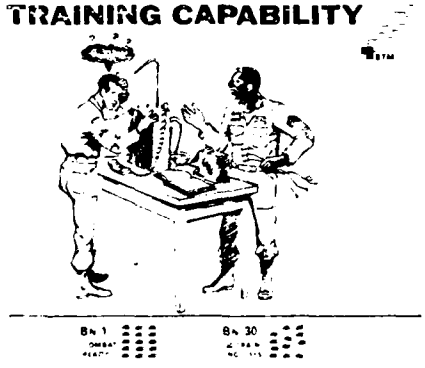
A percentage of fill affects more than the number of people available to do a task. When the shortage occurs among leaders, less experienced personnel must conduct training than would normally be the case.

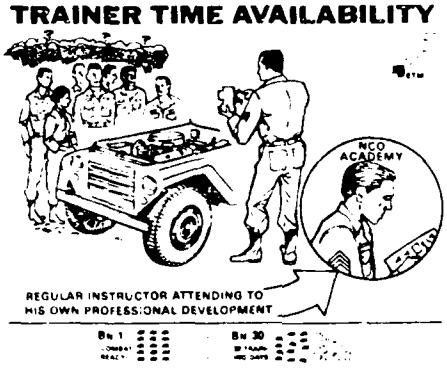




There are many reasons for soldiers not being present for training. While most all the reasons are good, the cumulative effect can be an unacceptable degradation of the unit's training readiness.

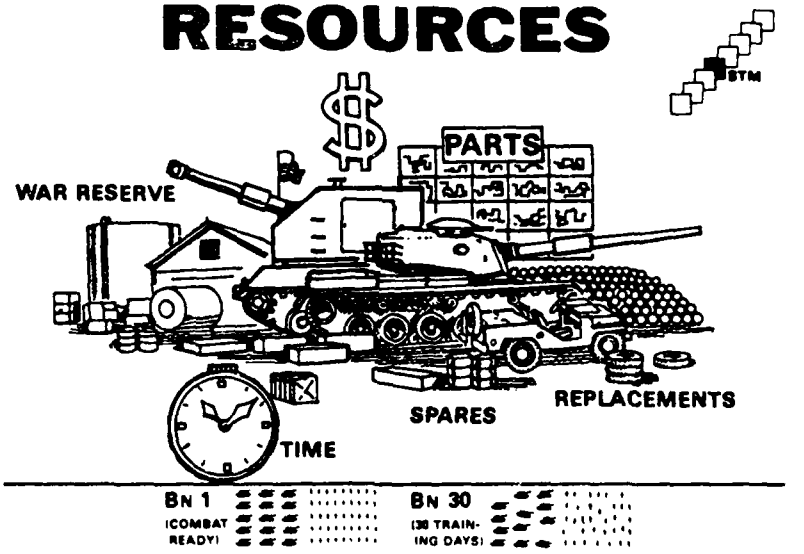
Block 2 describes the capability of officers/NCOs to conduct effective training, and the capability of soldiers to react favorably to the training. This block addresses such issues as the impact of a Specialist Fourth Class or Sergeant E5 as a tank commander or squad leader rather than the authorized Sergeant E6, and the effects of less qualified trainees.





Block 3 addresses the time available for trainers to conduct effective training and for trainees to receive it. Trainers, who are also required to continue their own professional development, or perform other duties (guard, CQ, etc.) are often not available to conduct training.

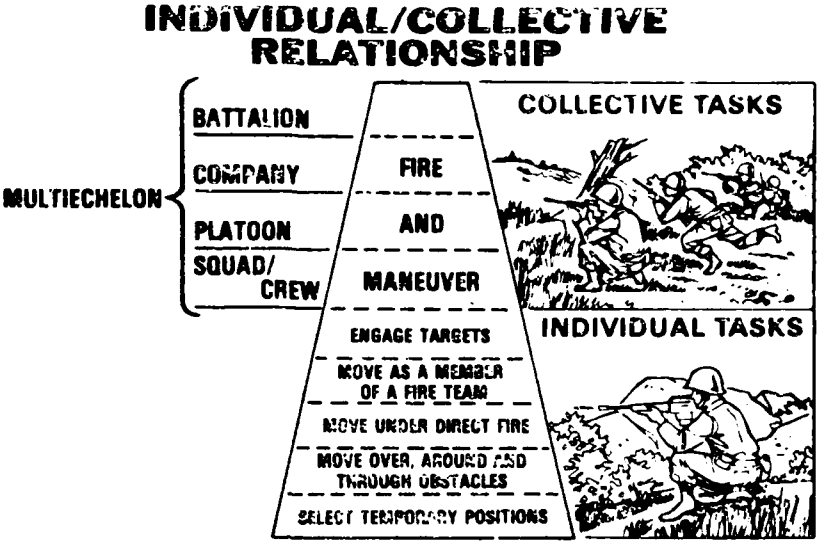
Blocks four and five address such resources as unit training time, ammunition, Class IX spare parts, POL costs, and training area/facilities availability.



These resources act as constraints, limiting the amount and nature of training which the unit can conduct.

The resources described above are allocated to training programs (block 6), which are described in terms of length of time to train and required frequency of retraining for ARTEP, soldier's manual and mission tasks--i.e., general defense plan (GDP) preparation, air/rail movement, civil disturbance, etc.—as well as other training activities such as large unit field training exercises, skill qualification test (SQT) preparation, and mandatory training (i.e., Geneva Convention, SAEDA, etc.).

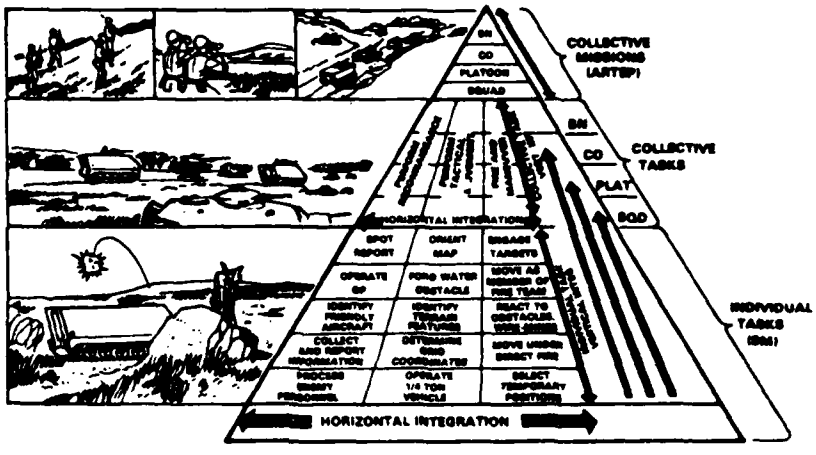
Times and frequencies are reduced to minimum acceptable levels by developing the concept of individual/collective task integration mentioned earlier. Currently, the parameters of this block are so comprehensive and their relationships so sophisticated that they require an off-line pre-processing computer program themselves. The essence of integration is that the training activities a unit must perform are composed of a relatively small number of unit performance requirements or collective tasks. Successful accomplishment of these tasks depends on soldiers performing certain individual tasks. Conversely, these individual tasks are learned best in the context of performing the collective task.



Performance of a given ARTEP mission provides training in performance of the same mission at different echelons. The same integration occurs when a collective task is performed at one echelon--some training benefit is passed to other echelons. This vertical integration in a slightly

different form passes through logical hierarchies of individual tasks. Horizontal integration occurs among collective and individual tasks when the skills developed in one task apply to successful performance of another task.

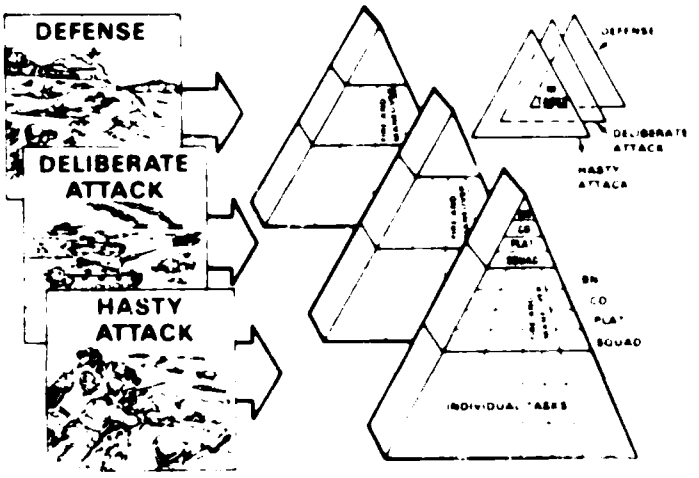
INDIVIDUAL/COLLECTIVE RELATIONSHIP



ARTEP missions are composed of the individual and collective tasks already discussed.

Integration also occurs in a "three-dimensional" fashion among those missions. The skills required to perform the hasty attack are also required for and developed in performance of the deliberate attack. To a lesser extent, certain skills are common between attack and defense.

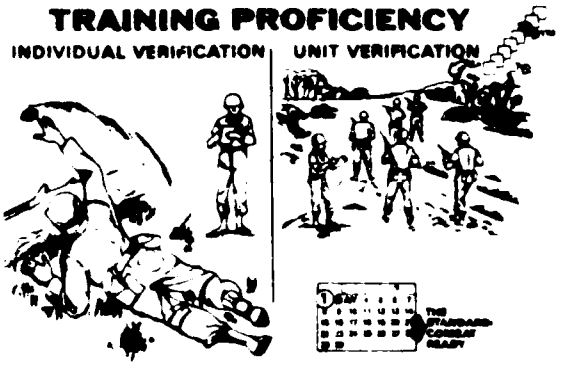
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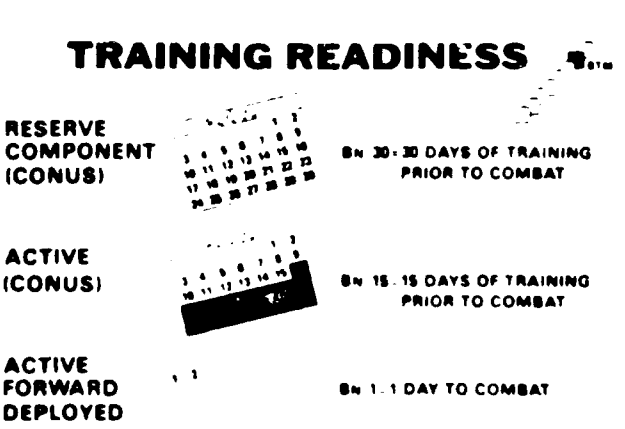


This commonality permits extensive time and dollar savings through integration of training events.

The foldout illustration (last page of Chapter 1) depicts the contruction of a training program based on integration and commonality. In Section 1 of the illustration, the results of a diagnostic ARTEP evaluation are coupled with the commander's judgment to determine the logical groupings of individual and collective tasks which require training. These groupings form training drills (Section 2) and battle drills (Section 3). The training drill, oriented on the more basic skills, normally is a forerunner to the battle drill and is conducted in the garrison environment. The battle drill, conducted in the field, provides the opportunity to exercise the integrated skills under varying conditions in a series of tactical problems. Section 4 illustrates the manner in which different combinations of a few basic battle drills provide the learning experience required for successful completion of the more numerous ARTEP missions. Since the ARTEP missions are the building blocks which comprise the elements of the unit's general defense plan (GDP) and other possible contingencies, the training program is complete when the ARTEP mission associated with the GDP and contingencies are performed competently.

For the present, training program accomplishment (block 7) is considered attainment of training proficiency. The BTM has been designed however, so that as the SQT testing program (individual proficiency) matures, and the instrumented battlefield (National Training Center) and sophisticated engagement simulation (MILES) become available, these proficiency ratings can be factored into the model. Training readiness (block 8) is expressed in terms of one baseline--the training time required to achieve 95 percent battlefield training proficiency (fully combat ready).

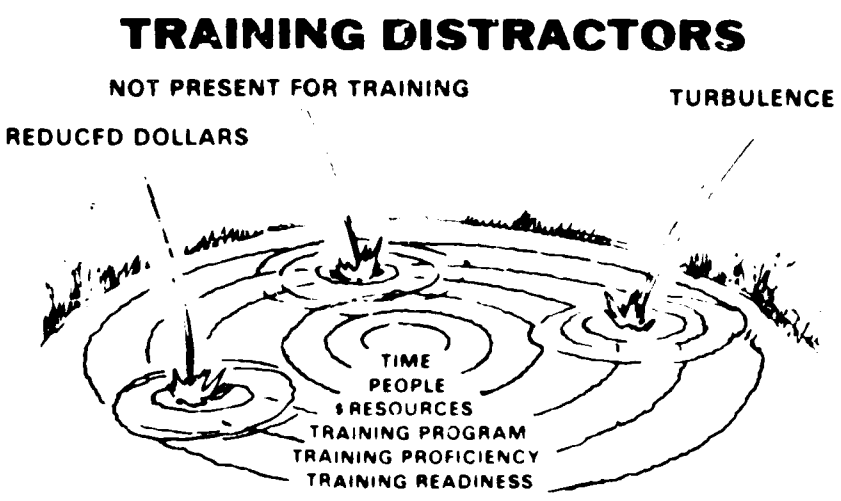




Once people and dollar resources are factored into a precise training program described by tasks, times and frequencies of repetition, the model will determine how many days are required to execute the program. If these days can be accommodated by the unit's master training schedule, then the unit is regarded as Bn-1, ready to fight and win tomorrow--the highest possible readiness rating. If its training schedule falls short by 15, 30, or 60 training days, the unit has a readiness rating of Bn-15, Bn-30, or Bn-60, respectively. Thus, the number associated with the rating indicates the days of training required between warning order and deployment for combat.

Concept of Operation

The model has a capability of making many different types of analyses. It can describe the impact of varying levels of turbulence, officer/NCO fill and present-for-duty strength on training readiness levels. It can describe the impact of officer/NCO professional development and of varying levels of soldier capability (mental category III versus mental category IV) on readiness. It will demonstrate the impact of reduced dollars, time, personnel and, eventually, training areas. For given conditions (i.e., turbulence, fill, present-for-training strength, etc.) and stated levels of resources and readiness, the model will describe an optimal training program in terms of tasks, times, and frequencies.



The model is also capable of addressing many different parameter value changes, and of optimizing several changing parameters simultaneously. For instance, it can address whether DA can overcome the effects of turbulence, turnover, and soldiers with lower mental capabilities by increasing time and dollars. Simultaneously, the BTM can outline a suitable training program (tasks, time, and frequencies) and resource mix (time and dollars) to accomplish the training required for varying readiness levels. In short, the BTM will be capable of performing credible analyses of most policy issues that impact training readiness, and, as a premium, provide a useful tool to help local commanders make important training program and budget decisions.

Methodology & Data

There were several reasons for formulating the BTM as a goal program. It was readily apparent that the interactions among all of a battalion's resources and requirements were too complex for manual analysis. An automated simulation was a necessity, because it could describe mathematically the required relationships. In addition, a modeling approach was desired which could assist in finding optimal or, at least, efficient resource allocations. Linear programming was considered because it has been used in this manner for analyses of petroleum production, transportation and marketing problems. The linear programming approach was also appealing because it is the basis of the FORSCOM Training Management Control System. Simple linear programming, however, is not well suited to a simulation of the battalion's situation, comprised as it is of a multitude of goals and constraints expressed in different units of measure.

Goal programming, an advanced variant of linear programming, satisfied most of the ARTS' needs for an optimality-seeking simulation and avoids most of linear programming's shortcomings. It can cope with a combination of incommensurable goals in its objective function because the goal programming algorithm seeks to minimize the differences between desired and actual activity levels -e.g., between resource requirements and available resources. The comparisons are each made within their own specific unit of measure, and then transferred into the objective function as absolute values. Goal programming can seek to achieve a given level of training or other activities for a minimum of resource expenditure. Conversely, it can allocate a fixed set of resources (dollars, time, mandays, and equipment) to a variety of activities to achieve the maximum possible level of activity for the constrained set of resources. Since each deviation is, by definition, compared with a goal or constraint expressed in an identical unit of measure, it is possible to treat each deviation as an absolute value when transferred into the objective function.

As an additional advantage, goal programming provides significant flexibility and power in the description and control of decision rules and priority structure. A decision maker can place simple ordinal rankings on the relative importance of achieving different goals. The algorithm will satisfy the most important goals first and accomplish lesser goals only to the extent that they do not detract from previous, more important goals. Alternatively, it is possible to place weighting factors on the component parts of a training program within one of the major priority categories. If a decision maker can attach specific numerical weights to the relative importance of the different parts of the training program, the algorithm can readily accommodate the weighting factors.

Using the goal programming approach, each aspect of the battalion's training environment can be expressed in terms of simple linear algebra. The simple algebraic expressions are linked using balancing equations within a matrix format, employing the modified Simplex algorithm which drives a goal program. The requirement for linearity poses a requirement to express some nonlinear relationships in terms of related, linear functions. For example, proficiency decay, which is non-linear, is expressed in terms of the linear function, required training repetitions per year.

To realize the full potential of the BTM, further extended developmental effort is required. The incomplete areas mentioned in Chapter II, particularly training area/facilities, should be developed and "soft" areas, particularly equipment usage, refined significantly. Furthermore, that part of the training program relating to integration should be placed on line with the remainder of the model. In its present configuration, the BTM is a research tool, requiring a high degree of expertise to use. It is suitable for use by senior headquarters supported by analytical personnel. As it is also intended for eventual use at the unit level, it will be necessary to develop a greatly simplified and miniaturized version that will be compatible with the ADP support which will be available to field units.

A follow-on data collection effort is also required. Individual/collective task integration factors formulated by the ARTS group and outlined in Annex F, G, and H require validation, as do the costs per type training day based on field estimates and Training Management Control System (TMCS) data. Further rigorous tests confirming proficiency as a function of frequency are also required. Current survey data is considered reasonably reliable but, where possible, it should be supported by analytical tests, particularly in relating turbulence, present-for-training grade substitution, and mental category levels to training frequency and proficiency. Data relating to time and frequency of repetition for both individual and collective tasks for which current survey correlation factors are marginal, should be derived from other analytical tests. Before current sensitivity analyses are used for important decision making, all current data should be verified by another survey, exploiting methodological advances learned through administration of the Battalion Training Survey (see Chapter II). Such a survey could also address Artillery, Signal, and Maintenance battalion tasks in addition to the Mechanized Infantry and Armor battalions. Finally, an urgent requirement exists for the conduct of troop tests relating equipment availability factors to training programs and proficiency.

Chapter II

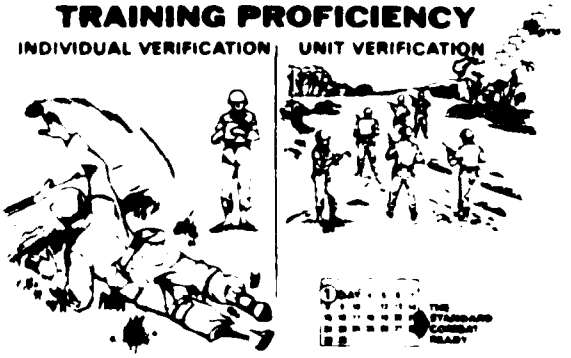
DETAILED DESCRIPTION

The following sections outline a detailed description of the BTM. This discussion addresses pertinent definitions, assumptions, sources of data, model formulation and general considerations for each area of interest.

Training Readiness

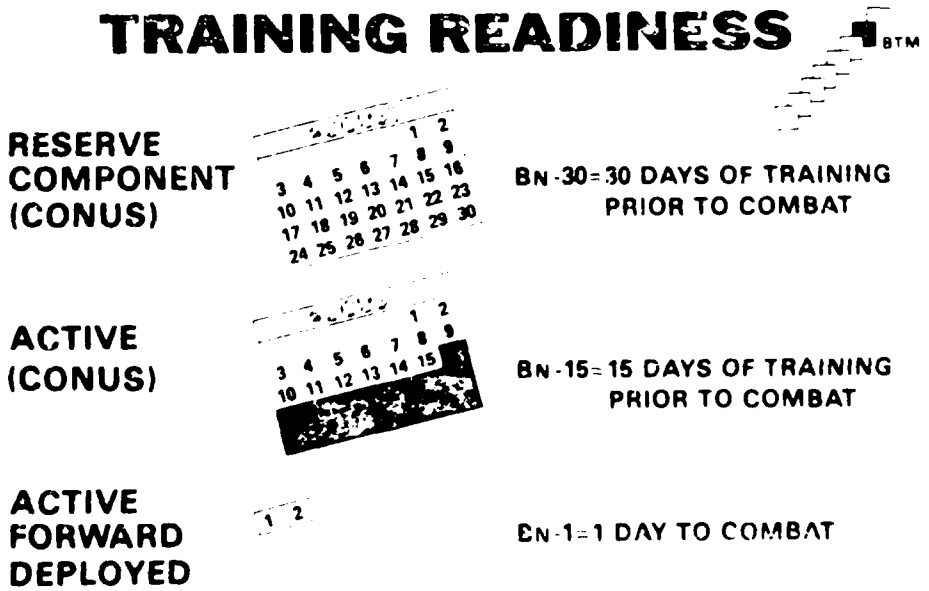
It is not now possible to measure a unit's ability to employ its full combat power to consistently defeat an opponent whose equipment is qualitatively equal and whose numbers are greatly superior. Verification of this combat capability must be deferred until the combination of independent tactical evaluation teams and an instrumented battlefield, such as the proposed National Training Center, permit an objective assessment. Until that time, the most readily available measure of training readiness is the degree to which a unit is able to maintain the level of training activity mandated by the training regimen determined to be necessary for success on future battlefields. The Battalion Training Survey outlines such a regimen, the consensus of an Army-wide cross section of selected Infantry and Armor leaders/trainers. The training is expressed in terms of duration and annual frequency for the missions in ARTEP 71-2, the collective tasks derived from that ARTEP, and the appropriate individual tasks outlined in soldier's manuals. Since each training activity can be related to resources, and readiness requirements can be expressed in terms of prerequisite training, it is possible to identify the training resources necessary to obtain different levels of readiness. Although the link between resources and readiness is drawn from the best information available, it is nonetheless based on subjective survey data rather than hard, confirmed testing. There is a need for extensive troop testing to determine the actual required level of unit proficiency and to verify the adequacy of the training requirements stated by the respondents to the Battalion Training Survey.





The Army probably does not need and the country almost certainly cannot afford to maintain every unit at a constant level of proficiency commensurate with full combat capability. Many, perhaps most, units will have a certain cushion of time between first warning and actual performance of their combat missions. If strategic planners can discipline and stabilize their deployment schedules, unit commanders can estimate their available training time and the training which can be fit into that time. The post alert training program could consist of high-cost skills which can be achieved fairly rapidly. A good example is the training of TOW gunners, which is rapid but expensive. This post-alert training program establishes the tasks, times and frequencies of repetition which the unit can reduce from its pre-alert training program without jeopardizing the unit's ability to achieve a combat-ready level of proficiency prior to entry into combat. The resultant reduction in pre-alert training can be quite dramatic because of the interaction among rapid train-up packages (see TEA Volume), skill decay curves, and the corresponding reduction in the steady state proficiency required during the pre-alert period. This concept is developed more fully in the Reserve Components concept paper and is the subject of several Battalion Training Model sensitivity runs (Chapter IV).

Under this concept, a finite number of training days can be used to identify the time required to reach full combat readiness (95%). Thus for the purpose of this model, a battalion that requires 5 days of training to be fully ready will be earmarked as Bn-5; one which requires 20 days of training will be regarded as Bn-20.



Training readiness is not addressed as a set of equations in the BTM, but as the result of two runs of the program. The first run determines the training which can be conducted in the period between alert and entry into combat. The procedure for accomplishing this is explained in detail in the discussion of sensitivity analysis (Chapter IV). The general process is to fix the maximum time for training at the desired number of post-alert days, request completion of a specific training program, and require the greatest possible fund expenditure--in effect time not dollars becomes the dominant resource. The BTM will then select the most expensive events for post-alert training. By planning expensive training events after the alert, more time can be permitted between repetitions of the expensive events during the pre-alert or sustainment period. As an example, the platoon shoot battle drill is the most expensive drill because of the ammunition it consumes. In the Battalion Training Survey, the Army's trainers stated that if the time between training repetitions were doubled, the duration of the training required to regain proficiency would be increased by one third. Thus, if the training time for each of the events contained in the post-alert training program is increased by one third, the time between repetitions for those events during the pre-alert sustainment training can be doubled and the number of annual repetitions halved.

This reduction in training might produce dramatic peacetime savings. However, it should be adopted only with extreme caution. The approach is viable only when all ammunition, POL, and repair parts are stockpiled; there is confidence in the estimated warning time; and training range and facilities will be available simultaneously for all units whose training has been decremented. If there is no solid assurance that these conditions will be met units will not be able to compensate during post-alert training for decremented pre-alert sustaining programs, and the decremented programs cannot be accepted.

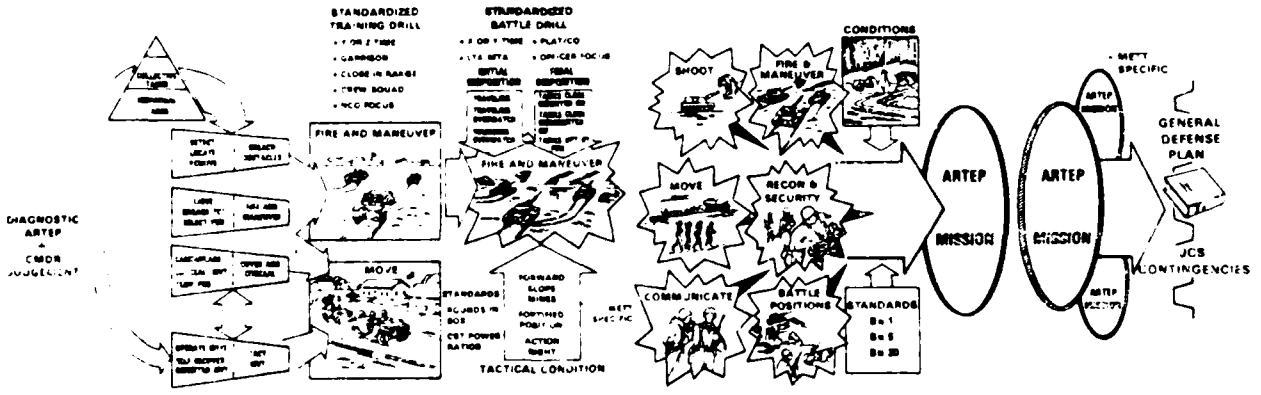
Training Program

This section will discuss the conceptual framework upon which the training program requirements were formulated. It will further discuss the analytical parameters used in the formulation, the sources utilized to obtain data for them, and the data which was used to package and schedule the training progam currently being used for sensitivity analyses. The training program was structured for a mechanized infantry battalion task force, training with a tank unit for combined arms training. Subsequent analysis should address the few modifications required to address an Armor battalion training with a mechanized unit attached.

Conceptual Framework

The basis for the conçeptual framework rests within the Unit Training Program concept paper. This framework focuses on time and frequency requirements for individual and collective tasks and ARTEP missions, with particular emphasis on the integration of the individual and collective tasks of the ARTEP missions in order to reduce these requirements and retard learning decay.

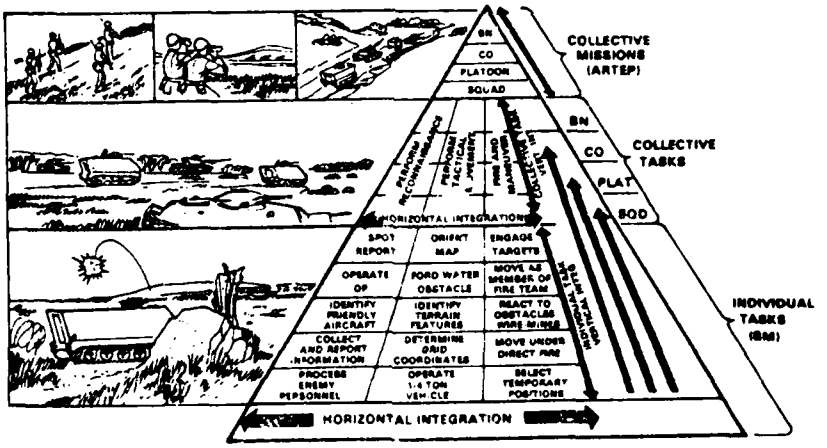
Complementary individual and collective tasks are aggregated and taught through battle drills and training drills. The former consists of a series of tactical problems described in the context of varied combat conditions. Solution of each problem requires execution of specific individual and collective tasks. Battle drills, embracing realistic time, distance, and condition factors, must be taught in a field environment. Training drills, which teach the basics of the essential battle drill tasks, embrace reduced time, distance, and condition factors, and are taught in garrison as a prelude to battle drill training. Training drills are focused at the crew/squad level and are designed to be taught by NCOs, while battle drills are focused at platoon/company level and are designed to be taught primarily by officers. When time, dollars, facilities, or availability of trainers preclude conduct of battle drills, training drills can be executed in their place, although it would result in a significant but not total loss in training proficiency.



Battle/training drills are grouped into ARTEP missions through clustering and an application of varying conditions (i.e., Europe, woods, night) and standards (i.e., 95% proficiency (Bn-1), Bn-30, Bn-60, etc.).

To determine precise training requirements, specific tasks, time to train these tasks, and the frequency of retraining required for skill retention must be identified. In determining the latter two--times and frequencies--integration performs a significant role. By allowing more than one task to be trained simultaneously, total training time requirements are reduced. Simultaneous training offers several benefits: Individual tasks can be taught concurrently with collective tasks; some collective tasks can be taught with other collective tasks; and some individual/collective tasks and ARTEP missions can be taught concurrently with other ARTEP missions. Isolation and quantification of these relationships is essential for accurate determination of required times and frequencies.

INDIVIDUAL/COLLECTIVE RELATIONSHIP

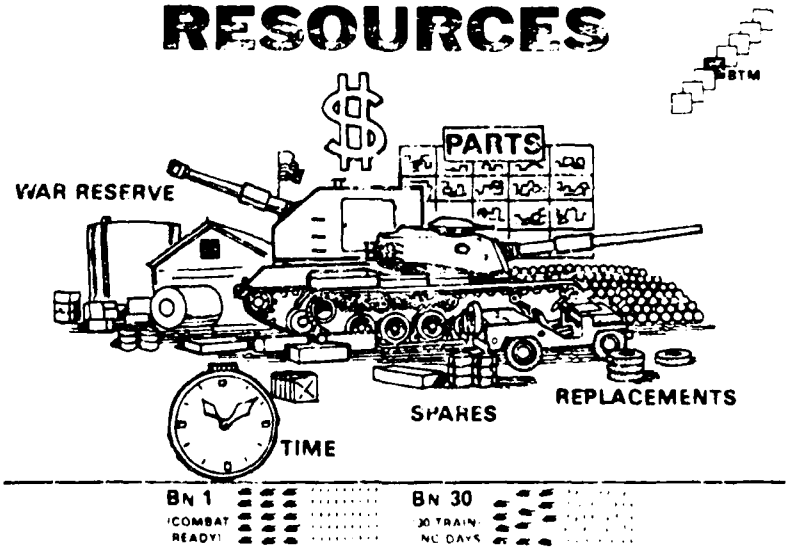


Data Sources

To formulate a training program for the BTM, the determination of precise tasks, times, and frequencies for given unit conditions and the relationship of these elements to resource elements were required. Data for this effort was gained from four primary sources: (1) Battalion Training Survey, (2) "Best Battalion" Costing Program, (3) the Training Effectiveness Analysis (TEA) '78 Program and (4) the Army Training Survey. Other sources such as the Total Tank Systems Study, Individual Extensive Training Study (IETS) and the Army Training Board's Individual/Collective Interface Study were useful in providing data and establishing suitable methodology approaches for the other data source programs.

The Battalion Training Survey, through aggregative techniques, obtained input data (time and frequencies) for all ARTEP 71-2 (Mechanized-Tank Task Forces) individual/collective tasks and ARTEP missions. (QL3) The data acquired was based on the assumption that units must achieve 95% proficiency or the ability to execute successfully all ARTEP tasks to 95% of the TOE capability of the unit, its weapons and its soldiers. (QL4) Answers regarding the impact of unit conditions (i.e., turbulence/turnover, etc.), training integration (e.g. times and frequencies) and proficiency were determined. This survey is the primary data source for the BTM. A further elaboration of its scope and results is included later.

The "Best Battalion" Costing Program, a representative study, embraced the costing of training programs of two mechanized and two tank battalions each in the 4th Division (Mech) at Ft Carson and the 3d Armored Division in the Federal Republic of Germany. (QL3) This effort identified the average time, dollar, and people costs of unit training-related activities. See Annex B.



Time costs were addressed by determining the number of days spent on battalion and company field exercises, gunnery, mission (i.e., ammunition uploading, air/rail movement, etc.), soldier's manual and non-soldier's manual (e.g. mandatory training) training. Other time costs associated with maintenance and non-training activities were also determined. Unit dollar training costs were determined by addressing ammunition, Class IX spare parts, and POL utilization. Ammunition costs were estimated by applying ARTEP guidelines to training events. Parts and POL costs were determined by applying dollars per mile/hours of operation factors to the number of vehicles/items of equipment utilized per type training. Personnel factors were addressed by scrutinizing records to determine officer/NCO fill, turbulence and not-present-for-training figures. (QL3) (QL4) (QL3) (QL3)

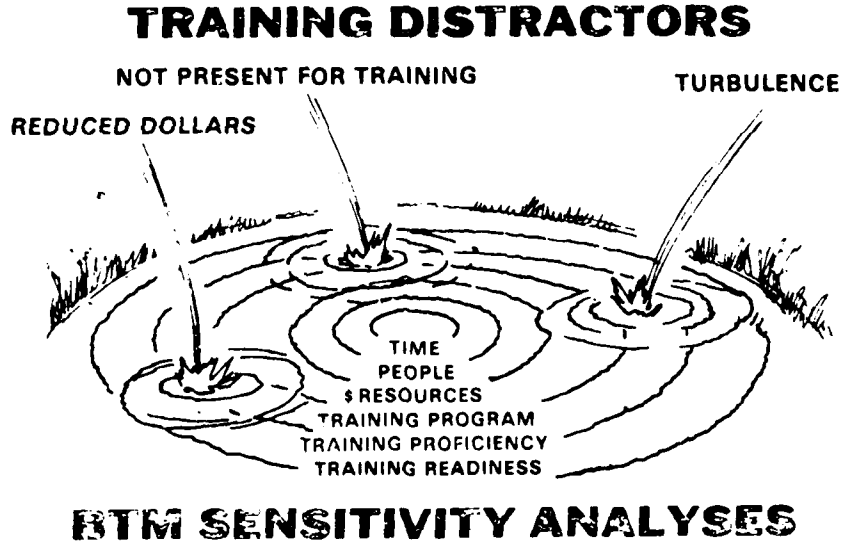
Time and dollar parameters identified during the costing effort provided insights for developing BTM parameters and units of measure. Actual data relating to gunnery, mission training, non-soldier's manual training, SQT preparation, maintenance and parts/POL costs per type training day were applied directly to the parameter values concerned. Results of the personnel costing effort were used as guidelines in adjusting the baseline training program to frequency standards that would lead to 95% proficiency, but which also would prescribe personnel conditions which could be accomodated by both the field and the Military Personnel Center (MILPERCEN). For more detailed information concerning this costing program, see Annex B.

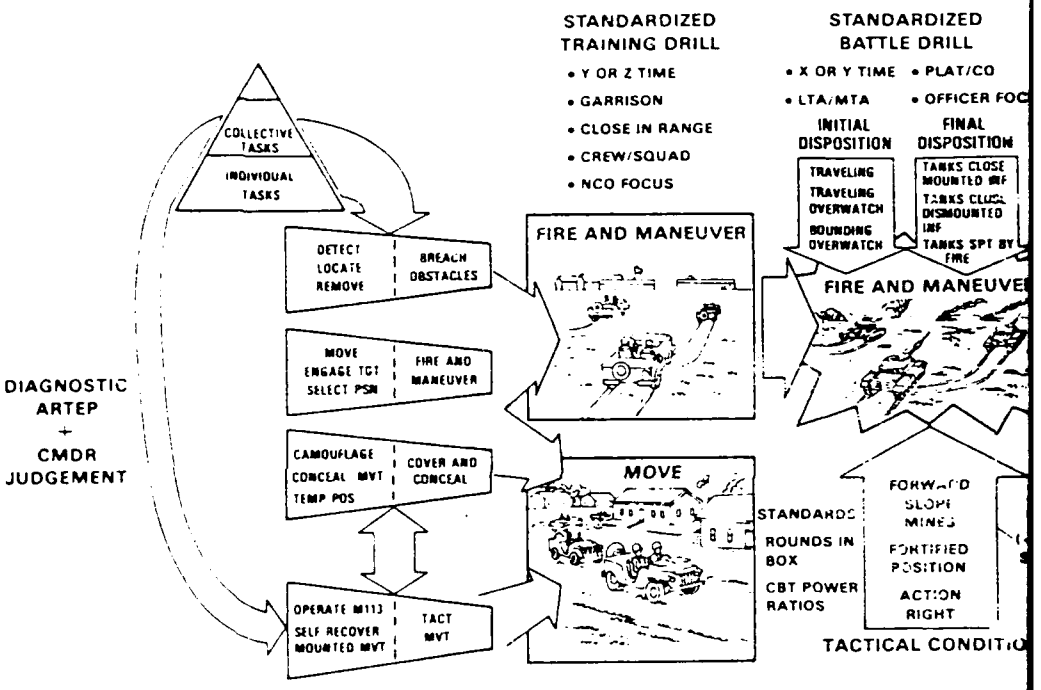
The training effectiveness analysis (TEA) '78 program will eventually provide accurate data for the BTM. It addresses time and frequency questions for many individual tasks and some collective tasks; as well as provide high confidence answers on turbulence, trainer/trainee capability, integration and similar issues. The tests address not only Armor and Mechanized Infantry skills, but Artillery, Ordnance and Signal unit's skills as well. MOS, command group, weapons systems and Reserve Component issues are also addressed. As these data are received during summer and fall 1978, they will be processed and used to refine the survey data already in the BTM. Follow-on TEA efforts are being recommended to fill data voids and verify data currently being used in the model (see TEA Summary Volume).

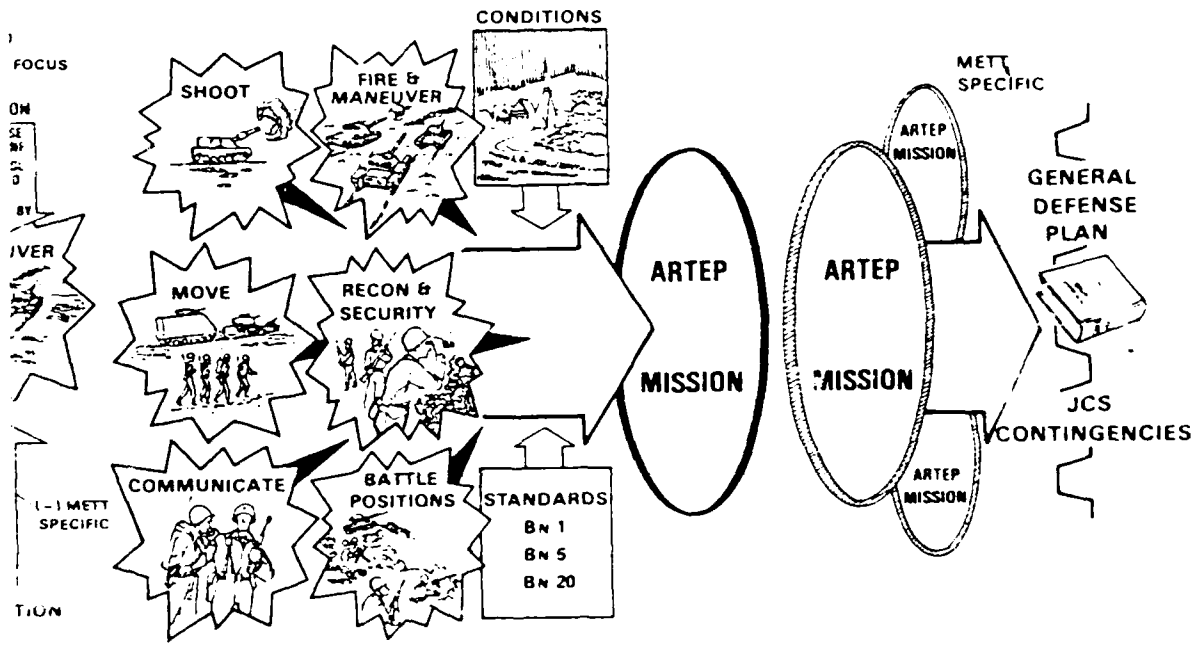
The ARTS Army Training Survey represents the last major source of data for the BTM. It has provided attitudinal data relative to turbulence, turnover, present-for-training and training guidance which has been pivotal in the packaging and scheduling of training tasks. This is covered in later paragraphs.

Battalion Training Survey

This survey, its findings, and final report are compiled in a separate volume. The BTS provided the majority of the data for the training program section of the BTM and was of overriding importance to current sensitivity analyses. The survey included data on the acquisition of time and training frequency relative to individual/collective tasks and ARTEP missions, and identified the impact of such issues as varying proficiency levels, integration, turbulence, not-present-for-training, trainer grade substitution and soldier capability on these times and frequencies. For a complete listing of the sensitivity factors, see Chapter IV. Finally, survey responses provided a meaningful tool to change training progams as time, dollar and people resources are decremented.




STANDARDIZED
TRAINING DRILL
• Y OR Z TIME
• GARRISON
• CLOSE IN RANGE
• CREW/SQUAD
• NCO FOCUS
STANDARDIZED
BATTLE DRILL
• X OR Y TIME
• LTA/MTA
• PLAT/CO
• OFFICER FOC
INITIAL
DISPOSITION
FINAL
DISPOSITION
TRAVELING
TRAVELING
OVERWATCH
BOUNDING
OVERWATCH
TANKS CLOSE
MOUNTED INF
TANKS CLOSE
DISMOUNTED
INF
TANKS SPT BY
FIRE
COLLECTIVE
TASKS
INDIVIDUAL
TASKS
DIAGNOSTIC
ARTEP
+
CMDR
JUDGEMENT
DETECT
LOCATE
REMOVE
BREACH
OBSTACLES
MOVE
ENGAGE TGT
SELECT PSN
FIRE AND
MANEUVER
CAMOUFLAGE
CONCEAL MVT
TEMP POS
COVER AND
CONCEAL
OPERATE M113
SELF RECOVER
MOUNTED MVT
TACT
MVT
FIRE AND MANEUVER
MOVE
FIRE AND MANEUVE
STANDARDS
ROUNDS IN
BOX
CBT POWER
RATIOS
FORWARD
SLOPE
MINES
FORTIFIED
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FOCUS
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ARTEP
MISSION
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SPECIFIC
ARTEP
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ARTEP
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ARTEP
MISSION
GENERAL
DEFENSE
PLAN
JCS
CONTINGENCIES

Certain critical features of the survey should be noted. First, it addressed only the Mechanized Infantry/Armor task force. With the number of tasks to be addressed and the sophistication required of the model, it has been impractical to address other battalions within the time limits of Phase I of the study.

Second, certain constraints were necessary regarding the manner in which individual tasks were aggregated. With some thirty MOS in the Mechanized Infantry and Armor battalions, and approximately one hundred individual tasks associated with each one, it was not realistic to acquire time and frequency for each task. Accordingly, it was assumed that if a battalion had sufficient time to train its 11B or 19D scouts, it had sufficient time to train the personnel in the remaining MOS. This assumption can be made with some assurance since the 11B/19D scouts have the most tasks associated with their MOS and the personnel assigned to these positions do not have a better than average learning rate. All skill level 1 11B/19D tasks were addressed, as were 40 percent of the skill level 2 tasks. The latter tasks were included because it was assumed that it would be mandatory for some duty time to be programmed for the professional development of E4's and E5's. High-cost individual skills for MOS other than 11B/19D skills, such as TOW and mortar firing, were also included. Based on the aggregations and simplifying assumptions, the survey requirements can be considered to address 100 percent of the training time costs and 90 percent of the dollar costs.

The Battalion Training Survey was administered to 277 officers and NCOs who were currently in mech/armor trainer positions or had just left such positions. Respondents represented battalion and company commanders and battalion S-3s from eight battalions each in the 4th Division (Mech) at Fort Carson and the 3d Armored Division in the FRG. Other respondents represented students and faculty from the Army War College, CGSC and the Sergeants Major Academy. Institutional responses were received from the two surveyed divisions, III and V Corps, and the Infantry and Armor Schools.

The survey was administered in the field by Army Training Study Group personnel to the smallest groups possible to obtain maximum response accuracy. In the case of the two divisions, the survey was delivered to groups of six, battalion by battalion, step by step. Rater reliability, survey credibility and response accuracy were further ensured by contracting survey design and processing to a civilian firm with excellent credentials in the field, by daily quality control by ARTS personnel throughout survey design, administration and processing, as well as classroom instruction and daily administrative coordination meetings. Prior to its administration, the survey was approved by DA MILPERCEN (approval number MSP-78-18) and reviewed by ARI and the Infantry and Armor Schools. Letters from these schools attesting to survey credibility are attached at Annex D.

Response to the survey was largely positive. Although complicated and requiring 3-5 hours to complete, it was well received by most in the field, particularly by the incumbent unit commanders and S-3s. The aggregation of individual tasks and the breakdown of ARTEP missions into collective tasks were also received favorably by the respondents. Significantly, survey results displayed remarkable correlation and represent the Army's best available data with regard to the precise training requirements of a mech/tank task force.

Detailed survey results and analysis are outlined in the Actuarial Research Corporation's final report, which is incorporated into a separate AMTS volume. Some of the findings are especially notable and are worthy of highlighting here. The respondents weighted most ARTEP missions and collective tasks equally. Where distinctions were made, they were made with a decided tilt toward defensive, rather than offensive, tasks and missions. The field placed high importance on maintenance and leader/commander tasks but relatively low importance on reconnaissance, security, and combat support (i.e., artillery, tactical air, engineer, etc.) tasks.

Another result of the survey was that the respondents felt that a certain amount of turbulence, grade substitution and not-present-for-training strength could be tolerated, but that there is a breaking point in each category beyond which the unit simply cannot remain combat ready within any feasible amount of training time. These breaking points appear to be 20% turbulence per quarter (approximately 10% turnover), 20% not-present-for-training, and 15% leader grade substitution (85% officer/NCO fill). For sensitivity analysis confirming these points, see Chapter IV.

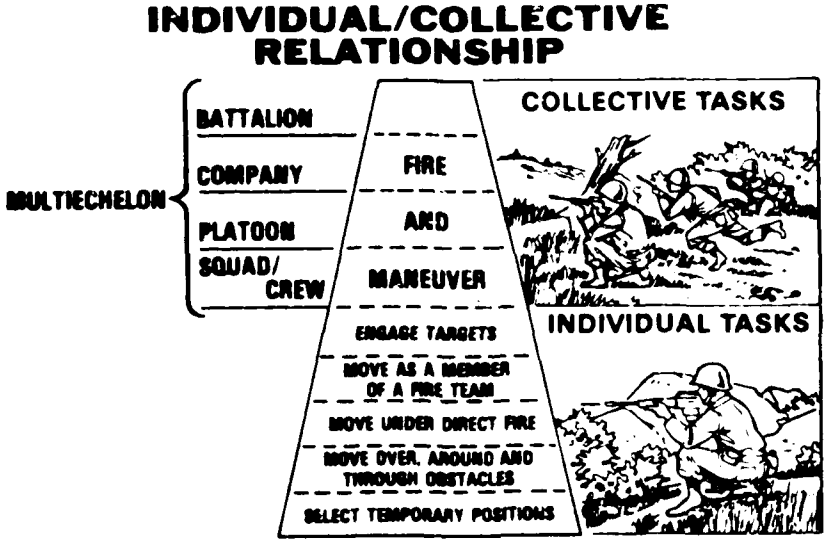
A third result was that Armor respondents opted for 50% of available time for maintenance, while Mechanized Infantry respondents opted for 37.5%. This is considerably more than the 21% actually being conducted by the units that were involved in the "Best Battalion" Costing Program. The maintenance times chosen by the respondents are not compatible with the times and frequencies the same respondents indicated were required for tactical training and gunnery.

Other notable findings pertain to training level emphasis, integration, time to train versus time to retrain and time to train mental category III personnel versus mental category IV personnel. Regarding training level emphasis, the respondents favored, in priority order, platoon, squad/crew, individual, company and battalion training when trade-off decisions relative to resources had to be made. Initial time to train a skill was found to be approximately double that required to reinforce the skill at a later date to make up for learning decay. This point has important ramifications for training efficiency/effectiveness in the institution versus in units, and a sensitivity analysis has been conducted on this issue (see Chapter IV). The final notable finding is that the survey respondents believe that it takes significantly more time and frequency to train lower mental category personnel. A sensitivity analysis of this matter has also been conducted (see Chapter IV). (QL-4)

Program Formulation

Applying the data outlined above to the conceptual framework described for the BTM, a first generation training program was formulated. Tasks, times, frequencies and integration data for specific unit personnel conditions, as determined in the Battalion Training Survey and amended by TEA '78 hard data, were molded into battle drills and ARTEP missions in consonance with attitudinal data outlined in the ARTS Training Survey. The training program was rounded out by applying "Best Battalion" Costing data relative to training, maintenance, mission and gunnery times. Annex E presents the battle drill formulations for each of the following: Shoot, Move, Communicate, Fire and Maneuver, Reconnaissance and Security, Battle Positions, Sustain, Support, Military Operations in Urban Terrain (MOUT) and NBC. These battle drills are made up of one or more of the collective tasks found in the survey, plus the complementary individual tasks which should be trained either concurrently or sequentially. The initial time and frequency for each drill is indicated and was determined by adding the times of the individual and collective tasks and taking the worst case frequency within the 95% confidence limits.

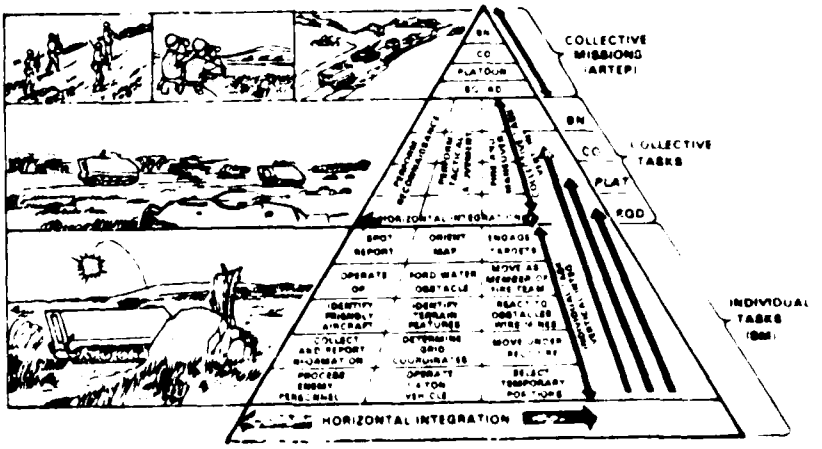
It should be noted that times and frequencies of the individual, crew, squad and platoon tasks are factored into a single battle drill called platoon battle drill, while company tasks are consolidated into a company battle drill. Separate, high-decay individual task elements were formulated when the frequencies of these tasks would have driven the battle drill frequencies to an "over-kill" status.



Once these battle drill packages were formulated, integration factors were applied to modify frequencies to reflect time economies which could be achieved in the field. Collective task vertical integration (i.e., training credit a squad received for performing in platoon, company and battalion exercise) was already subsumed in the Battalion Training Survey Part IV data. Individual task vertical integration (i.e., training credit an individual task receives for its performance in crew, squad, platoon exercises, etc.) was achieved by linking these tasks to each frequency of the collective tasks within the battle drills. Collective task horizontal integration (i.e., training credit the tactical movement task receives when the fire and maneuver or reconnaissance task is exercised) was achieved through use of the table in Annex F. This table was developed by Army Training Study Group personnel; survey pre-tests and expert advice from outside agencies indicated that this was too sophisticated a concept for inclusion in the initial survey to generate data. Including this in addition to everything else could have compromised the validity of the overall effort by "overloading" the survey.

Once battle drill times and frequencies were established, the ARTEP times and frequencies established by Battalion Training Survey results were reduced by the integration factors found in Annexes G, H, and I. Annex G outlines ARTEP vertical integration factors (i.e., training credit for squad movement to contact when such exercises are conducted in the platoon, company, and battalion). Annex H also outlines ARTEP three dimensional integration factors (i.e., the frequency credit which a platoon receives for hasty attack when company and battalion deliberate attacks are conducted). Annexes G and I display battle drill to ARTEP integration factors (i.e., the training credit a company receives for deliberate attack when company and platoon battle drills are conducted).

INDIVIDUAL/COLLECTIVE RELATIONSHIP



Battle drills and ARTEP times and frequencies were reduced by the integration factors indicated above through use of several computer runs. The results are attached at Annex J. Basically, the runs indicated that battle drills are an efficient training medium--so efficient, in fact, that they negate the training requirement for conducting the ARTEP missions. A training program with no ARTEP missions is unacceptable, however, because the linchpin of the battle drill concept is the use of diagnostic ARTEP's. Quarterly 3-day battalion multiechelon ARTEP's were included in the program.

In addition to the training/battle drill and individual high decay task times and frequencies outlined in Annex E, and the four 3-day diagnostic ARTEP's, the training program includes a number of other scheduled events. The "Best Battalion" Costing Program provided data for three of these--mission tasks such as rail/air movement (8 days), SQT preparation (5 days) and non-soldier's manual individual tasks (6 days). The costing program also provided data for a maintenance program which, although not training, must be factored into the year's schedule. The maintenance program is explained in detail later in this chapter. (QL3)

Another element of the program is gunnery, which is an integral part of the shoot battle drill. As such, individual arms qualification exercises are conducted once a year. Verification of proficiency is conducted three times a year. Crew-served weapons are fired once a quarter, one period for qualification and three periods for proficiency verification. The three familiarization periods can be a combination of live fire abbreviated tables and sub-caliber firing. Two separate shoot battle drills have been formulated, one for a Mechanized Infantry Battalion and one for an Armor Battalion.

Further, one company, and one battalion-level combined arms live fire exercise (CALFEX) is conducted per year. A number of other training activities, such as leader training, division and brigade FTX's, etc., are discussed in detail in a subsequent section of this chapter.

Model Formulation

After the training program was formulated and scheduled, it was applied to the Battalion Training Model, where it is expressed as a series of equations. The row and column values referred to in this and subsequent sections address the BTM as used for conduct of the ARTS sensitivity analysis. See Annex A.

The first requirement is that the unit conduct four ARTEP diagnostic evaluations per year. Thus, the following equation results:

$X_1=4$; Avoid negative deviation from the goal of four repetitions.

The allocation of time, instructors, and ammunition is addressed in detail in subsequent sections. For the present discussion, however, note that each repetition of an ARTEP diagnostic evaluation requires the consumption of three battalion field training exercise (Bn FTX) days, $88,985 worth of training ammunition and 332 instructor man-days (MDYS). These parameters and values are factored into the model in the following manner:

NAME	Variable	Coefficient Value	Source
Bn FTX Days	X78,1	3	ARTEP 71-2 Abbreviated Evaluation
Ammo $	X83,1	$88,985.	ARTEP 71-2 Ammunition Guidelines
Trainer MDYS	X102,1	332	See section on personnel

The following definitions apply:

Bn FTX Days = Calendar days in the field devoted to battalion-level activity

Ammo $ = Requirement for all types of training ammunition expressed in dollars

Trainer MDYS = Requirement for officer/NCOs to prepare, conduct and supervise training, expressed in man-days.

Use of the ARTEP as a diagnostic evaluation tool, in conjunction with the Commander's judgement, defines the skills which must be developed or refreshed through use of battle drills. Should it be desired to use ARTEP missions as the vehicles for the conduct of training, the BTM can accomplish this. A position is provided for each of the missions of the pacing subordinate units of the mechanized or tank battalion. For the mechanized battalion, these are the Mechanized Infantry squad, platoon, company and battalion. The equations are in the following form:

$X_{i,j} = b_i$; avoid negative deviation from b_i

where $X_{i,j}$ = the appropriate ARTEP mission

b_i = the annual frequency of training for ARTEP mission mandated by the Battalion Training Survey and the requirement for integration

i,j = row and column designators taking the values 2-39 in unison ($X_{2,2}$; $X_{3,3}$; $X_{4,4}$; etc.)

If the ARTEP section were used, it would be necessary to insert values for the appropriate training activity days, ammunition requirements and trainer mandays in the following manner:

Name	Coefficient	Variable	Source, if used
Bn FTX days	$a_{78,j}$	X_j	Battalion Training Survey (BTS)
SUE FTX days	$a_{79,j}$	X_j	BTS
CPX days	$a_{80,j}$	X_j	MACOM, Division guidance
TEWT days	$a_{81,j}$	X_j	" " "
Garrison days	$a_{82,j}$	X_j	BTS
Ammo $	$a_{83,j}$	X_j	ARTEP 71-2
Trainer MDYS	$a_{102,j}$	X_j	See discussion on personnel

Definitions for the days used in these formulations are:

SUE FTX days = Calendar days in which all subordinate units, company and below, are in the field and engaged in training oriented toward developing proficiency at company level and below.

CPX days = Calendar days in which the company and battalion command elements are engaged in command post exercises or similar activities, such as battle simulation.

TEWT days = Calendar days in which the unit chain-of-command is engaged in training exercises without troops.

Garrison days = Calendar days devoted to classroom or similar training which consumes few or no dollar-sensitive resources.

Unless otherwise noted, all training time requirements are divided between field and garrison training on a .75/.25 basis. Seventy-five percent of the required training hours specified in the Battalion Training Survey are allocated to field training and 25 percent to garrison training. Although training time is planned in hours, resources are most easily allocated to days. Both USAREUR and FORSCOM have developed cost factors in terms of days. To be compatible, the training hours from the Battalion Training Survey are converted to fractions of a 10-hour field day or an 8-hour garrison day in the BTM.

Battle drills make up the bulk of the individual and collective training program. They appear in the BTM in exactly the same manner as do ARTEP missions for training. For instance:

$X_{i,j} = b_{i,j}$; avoid negative deviation from b_i

where

$X_{i,j}$ = the appropriate battle drill

b_i = the frequency of training mandated by the Battalion Training Survey and the requirement for integration

i,j = row and column designators taking the values 40-56 in unison ($X_{40,40}$; $X_{41,41}$; etc,)

Each battle drill requires the following resources:

Name	Coefficient	Variable	Source
SUE FTX days	$A_{79,j}$	X_j	BTS, battle drills
TEWT days	$A_{81,j}$	X_j	BTS, battle drills
Garrison days	$A_{82,j}$	X_j	BTS
Ammo $	$A_{83,j}$	X_j	ARTEP 71-2
Trainer MDYS	$A_{102,j}$	X_j	See personnel section

for $j = 40$ through 56

Most of the battle drills consume SUE FTX days for that portion which is field training. The support battle drill is comprised of leader training and the pertinent field time is taken as equivalent to a training exercise without troops. The shoot battle drill is unique. It requires different amounts of time for different weapons systems. This drill, for Mechanized Infantry, at the platoon level, requires small arms, TOW, mortar, and garrison days. At the platoon level, the battalion requires small arms, scout, TOW, mortar, tank main gun and garrison days.

The other training events mentioned earlier under program scheduling are treated as follows:

a. Other battalion training represents FTX's other than ARTEP diagnostics.

Other Tng $X_{57,57}$ = 12 days; avoid negative deviation from 12.
Each such day consumes one Bn FTX day.

b. Leader training; CPX, gaming simulation, etc., receives 48 days.
Ldr Tng $X_{58,58}$ = 48 days; avoid negative deviation from 48.
Each day of leader training consumes one CPX day.

c. Formal classes for the development of noncommissioned officers are conducted one afternoon per month, giving the equation.

NCO Tng days $X_{59,59}$ = 6; avoid negative deviation from 6.

d. Athletics and recreation are scheduled 4 hours per week during garrison training time.

ATH and REC $X_{60,60}$ = 20 days; avoid negative deviation from 20.

e. SQT preparation is time formally set aside to prepare for and conduct the SQT. The "Best Battalion" Costing Program indicates a need for at least the 5 days indicated in the model. It appears that many Army units spend far more than this for SQT preparation. However, the seemingly low figure was entered into the model because of the anticipated benefits from the intensive individual skill training integrated into the battle drills.

It is not sufficient that the unit as an entity receive SQT preparation. Rather, it is necessary that a high percentage of the applicable personnel be afforded the training. If the commander's goal is that 90% of his personnel in grades E1-E4 receive a full 5 days of training and only 45% of the unit is present for training on any given day, the instruction must be provided at least twice. The BTM addresses the problem in the following manner:

1. Conduct SQT preparation once.

SQT prep RQT $X_{61,107}$ = 1; avoid negative deviation from 1.

2. SQT preparation is complete when 90% of the assigned E1-E4 have received the complete program.

(a) Calculate assigned strength.
E1-E4 $X_{114,64} = 536$; avoid positive deviation from 536.

(b) Assign a balance ratio to % SQT prep completion.
Complete SQT prep = .90 (Assigned E1-E4)
- .90 (Assigned E1-E4) + Complete SQT prep = 0
- .90 $X_{66,64} + X_{66,107} = 0$

(c) Calculate the % of E1-E4 present for SQT preparation during X, Y, Z days. For the BTM sensitivity analysis the % present for training during X, Y, Z days is held constant because of the need to investigate precise effects. In reality, one would expect the % present for training to be different during X, Y, or Z days. (See Annex B).

E1-E4 present during X, Y, or Z days = (average percent present during X, Y, Z days) (total number assigned)

- (average percent present during X, Y, or Z days) (total number assigned)
+ (E1-E4 present during X, Y, or Z days) = 0

X days - .75 $X_{105,64} + X_{105,67} = 0$

Y days - .75 $X_{108,64} + X_{108,70} = 0$

Z days - .75 $X_{111,64} + X_{111,73} = 0$

(d) Calculate SQT completion if the training is conducted during X, Y, or Z days.

% completed during an X period = % present for training/X period

- (% present for training/X period) + (% completed during an X period) = 0

- $X_{68,67} + X_{68,108} = 0$

- $X_{69,70} + X_{69,109} = 0$

- $X_{70,73} + X_{70,110} = 0$

(5) Balance the SQT prep requirement against the SQT prep completion in X, Y, Z time.

- (SQT prep Rqmt) + (SQT prep/X days) + (SQT prep/Y days) + (SQT prep/Z days) = 0

$$- X_{67,107} + X_{67,108} + X_{67,109} + X_{67,110} = 0$$

3. Each repetition of SQT prep consumes X, Y, or Z days as appropriate, as well as ammunition and instructor mandays.

4. The requirement to complete a full SQT preparation will cause the BTM to seek the most economical means to allocate the available X, Y, or Z days in sufficient quantity to ensure that 90% of the unit is exposed to a full 5 days. (QL4)

The shortcoming of this approach, however, is apparent. Personnel absent from training during any given day are not necessarily present on the following day. Thus, some personnel (those normally present) receive unnecessarily lengthy training, while chronic absentees receive little or none. Until the model can be refined, however, the SQT preparation section provides a reasonable approximation of the training resources required for a given standard and set of personnel conditions.

f. Every unit has specific non-ARTEP mission training requirements, such as the need to conduct civil disturbance training. As indicated earlier, the "Best Battalion" Costing Program indicates that 8 days are appropriate for this training, as expressed in the following equation.

$X_{63,105} = 8$; avoid negative deviation.

g. Soldier's manual training covers the high decay individual skills which are not fully included in battle drills. The frequency requirements of the Battalion Training Survey determine the time allocated to this training activity. The following equation depicts the requirement.

SM TNG DAYS $X_{71,111} = 15.33$ days; avoid negative deviation. (QL3)
Soldier's manual training consumes garrison days and instructor mandays.

h. Non-soldier's manual training addresses subjects like the Geneva Convention, Code of Conduct, and equal opportunity training. The Best Battalion Costing Program is the basis for the requirement.

NON-SM TNG DAYS $X_{72,112} = 6.33$; avoid negative deviation. (QL3)
This training also consumes garrison days and instructor mandays.

i. One week of unannounced AGI and 1 day of AGI spotcheck were programmed, as was 1 week for a command maintenance evaluation (COMET). (QL3) These figures are consistent with the Best Battalion Costing Program data. The AGI and command maintenance evaluation are subsumed in non-training time. As such, they place a limit on the number of days available for training.

j. TOW and mortar training are accounted for in the shoot battle drill. Scouts, Redeye, and Ground Surveillence Radar are alloted training days (for dollar costing only) and costs per day based on the "Best Battalion" Costing Program and analysis of typical training Management (QL3) Control System data.

SCOUT TNG DAY	X75,102 = 6
REDEYE TNG D	X76,103 = 15
GSR TNG DAYS	X77,104 = 20

Avoid negative deviations

This training is in addition to completion of the appropriate amount of battle drill training and participation in battalion exercises. These training days consume POL, parts, and ammunition.

Within the BTM, calendar time is allocated as required by the pacing units--*Mechanized Infantry or Armor*. There is an assumption that the combat support elements will be able to complete their training requirements within this same amount of time because they generally have fewer missions and tasks to perform. Nevertheless, dollar costs are incurred when they conduct their training and these costs must be included.

The maintenance time presented in the BTM is formally scheduled. It does not include daily operator and crew maintenance which are factored into the battle drills. In addition, 30 days of maintenance for the sustain battle drill are included under the training program rather than under the maintenance program.

Based on a hypothesized schedule in which X, Y, and Z time alternate at 2-week intervals, maintenance is scheduled in the following manner. Once per quarter, 1 week is devoted to maintenance standown. This is scheduled during Y time, when there are sufficient supervisors and personnel available to conduct extensive maintenance (unlike Z time) and so as not to interfere with prime training time (X time). Once during every non maintenance-standown month, 2 days are devoted solely to maintenance. Where possible, this is scheduled during Y time; otherwise, it appears in Z time.

Once during each Y or Z week which does not contain one of the maintenance periods above, 1 day is devoted to maintenance. Application of this policy to the training calendar of a FORSCOM unit indicates that this policy translates into 39 days of Y time and 19 days of Z time per year. Deduction of the 30 days of maintenance in the sustain training drill leaves 19 Y days and 9 Z days entitled maintenance, as indicated below

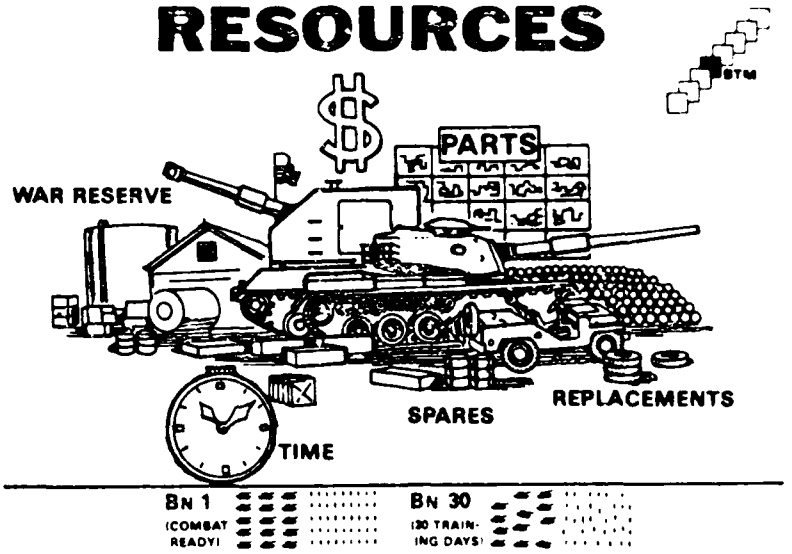
$$X_{100,87} = 19$$

Avoid negative deviation. (QL4)

$$X_{101,88} = 9$$

Formulation of the analytical baseline, a training program for units experiencing 85% officer/NCO fill, 35% quarterly turbulence (17.5% quarterly turnover), and 25% not-present-for-training was developed, scheduled and factored into the BTM. The program required total training and maintenance time of 271 days a year. Considering national holidays, a 2-week Christmas break, and non-X time weekends, there are only 253 usable (QL3) days a year. Not only did the analytical baseline involve extensive weekend training, it left no time for non-training activities such as AGI, COMET, post support, ceremonies, etc. Since such a program could not actually be conducted, new personnel conditions of 85% officer/NCO fill, 20% quarterly turbulence and 20% non-present for training were developed and the program was re-run in the BTM. By reducing the time and frequencies in the appropriate survey factors, time requirements of the training program were reduced to form the 95% baseline (Bn-1) training program for a combat ready (Bn-1) Mechanized Infantry/Armor Battalion.

When frequencies based on the new personnel conditions were factored into the model, a training program emerged with 141 days for training, 58 days for maintenance and 54 days for non-training activities, with no (QL3) weekend or holiday training. .This represents a program that will permit a unit to attain a 95% training proficiency standard, allow a requisite amount of time to achieve maintenance readiness, and address volunteer Army and housekeeping requirements.



The remainder of the BTM deals with the management and allocation of resources. The primary interface between resources and the training program is a group of transitional training modes, so-called because they represent the common ground between the training program/activities of the trainer and quantitative requirements of the resource manager. Each train ing mode relates to one or more training activities and carries with it a cost of Program 2 (P2) dollars for gasoline, diesel fuel and Class IX repair parts. The costs were derived from the Best Battalion Costing Progra (Annex B) and represent the best available data.

The transitional training modes presently used in the BTM were defined in the section on training programs. They are Bn FTX, SUE FTX, CPX, TEWT, mission, garrison, small arms, TOW, scout, Redeye, and GSR training days. These appear to be the most suitable for use with FORSCOM units. For USAREUR the modes would be modified to account for Local Training Area (LTA), Major Training Area (MTA), etc.

The training modes which address activities of the pacing units carry a calendar day cost which is allocated to X; X and Y; or X, Y and Z time depending on the feasibility of conducting that mode of training in the various categories of training time. As an example, the Bn FTX can only be conducted during X time, when troops and training area are available. The CPX can be accomplished during X, Y, or Z time, since only command groups and very limited training area are required.

While program 2 resources are best fitted to the transitional modes, ammunition requirements were allocated to specific training activities. (QL4) Since battle drills represent the bulk of the 95% baseline training program and there is no usage data for battle drill ammunition requirements, ammunition represents the weakest data input to the BTM. The problem was complicated because of the fact that units do not have the same level of experience with ammunition costs as with program 2 costs, because the Training Ammunition Management Information System is very new. The training ammunition allocated to the various training events is the product of the application of military judgement to the ARTEP 71-2 ammunition guidelines to derive estimates of battle drill ammunition requirement The requirement has probably been overstated.

The impact of vehicle/equipment availability on training readiness is addressed by linking this availability to the training mode day in a "go-no-go" manner. If vehicle/equipment-on-hand rates and operational rates (OR) both reach 75% for a maneuver exercise and 50% for a firing exercise, the program will favorably consider the exercises. If the rates fall below these standards, then the exercises will not be validated for (QL4) the training program. The standards selected (75% and 50%) are tied to vehicle/equipment requirements commensurate with the 20% personnel not-present-for-training rate, the pivotal point for reaching 95% proficiency (See chapter IV, Sensitivity Analysis). The firing exercise standard was lowered to 50% because the nature of this training makes it practical to use equipment pools. Using this rationale, conduct of a day of Mechanized Battalion FTX is hypothesized to require the availability and use of 40 M113 APC's, 9 mortar carriers and 13 TOW carriers.

As has been indicated, training time is treated in terms of X, Y, and Z periods, with X days being prime training time. Then, the unit is as free as possible from non-training requirements and has top priority to utilize ranges and large training areas. During Y periods, the unit does not have priority for major ranges or large training areas but may have access to limited amounts of training land. Units in Y time normally experience higher non-training requirements than they do during X time. Reasonable amounts of secondary training or maintenance can be conducted then. Z time is normally dedicated to post support and other commitments. Some training may be conducted, but it is normally limited to garrison training. In the previous section, training modes were designated as suitable for X time only (primary training), X or Y time (secondary training) or X, Y, Z time (limited training). These designators link the days of each training mode to the appropriate training category. Since the BTM only tracks calendar time for the pacing sub-units, other sub-unit activity such as TOW Tng Days, are not included in this calculation. Times for this section were extracted from the "Best Battalion" Costing Program, and modified to relate to the ARTS Training Program. Maximum permissible X, Y, Z days were entered as indicated below:

X days X95,82 = 85, Avoid positive deviation

Y days	X96,83	= 85, Avoid positive deviation
Z days	X97,84	= 83, Avoid positive deviation

Non-training days represent weekends, holidays and work days during which no training can occur, such as during parades and organization day activities.

The initial equations for the days of training mode take two forms; balance equations and direct equalities:

$$\text{Bn FTX Days} \sum_{j=1}^{39} (\text{Bn FTX Days/ARTEP event j}) (\text{repetitions of ARTEP event j})$$

$$+ (\text{Days of other Bn Training}) = \text{Total Bn FTX Days}$$

$$- \text{Total Bn FTX Days} + \sum_{j=1}^{39} (\text{Bn FTX Days/ARTEP event j})$$

$$(\text{repetition of ARTEP event j}) + \text{Days of other Bn Training} = 0$$

or:

$$- X_{78,95} + \sum_{j=1}^{39} (a_{78,j} X_{78,j}) + X_{78,57} = 0$$

SUE FTX DAYS: Follow the same format but include additional training activities, such as battle drills.

$$- X_{79,96} + \sum_{j=1}^{56} (a_{79,j} X_j) = 0$$

CPX DAYS: $- X_{80,96} + X_{80,58} = 0$

TEWT DAYS: $- X_{81,98} + a_{81,54} X_{81,54} = 0$

Garrison Days: $- X_{82,106} + \sum_{j=1}^{60} (a_{82,j} X_{82,j}) = 0$

Small Arms Days: $- X_{64,99} + a_{64,42} X_{64,43} = 0$

Mortar Days: $- X_{73,100} + a_{73,43} X_{73,43} = 0$

TOW TNG Days: $- X_{74,101} + a_{74,43} X_{74,43} = 0$

Mission Days: $X_{63,105} = b_{63}$

SM TNG Days: $X_{71,111} = b_{71}$

Non-SM Days: $X_{72,111} = b_{72}$

Scout TNG Days: $X_{75,102} = b_{75}$

Redeye TNG Days: $X_{76,103} = b_{76}$

GSR TNG Days: $X_{77,104} = b_{77}$

Table II-1 on the following page, records the costs attributed to each training mode.

Non-training days includes weekends, holidays and time set aside for non-training activity, such as AGI, maintenance inspections, etc.

Non-Tng days $X_{98,85} = 158$; avoid positive deviation

Total time in the year:

X time + Y time + Z time + non-tng time = 365

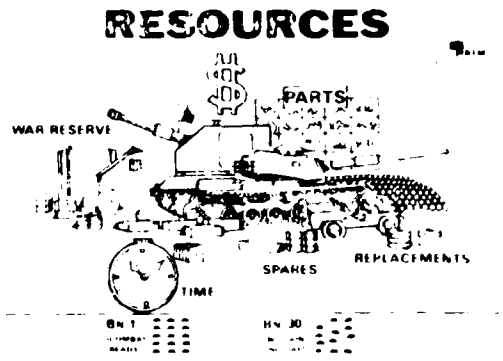
$X_{94,82} + X_{94,83} + X_{94,84} + X_{94,85} = 365$; avoid positive deviation

Integrate maintenance time into X, Y, Z days (See previous section on maintenance).

Maint X days $X_{99,86} = 0$; avoid positive deviation

Maint Y days $X_{100,87} = 19$; avoid negative deviation





Cost/Training Mode Day (QL3)

	Bn FTX	SUE FTX	CPX	TEWT	Small Arms	Mortar	TOW	Scout	Redeye	GSR	Mission	Garrison
MOGAS $	245.	54.	102.	156.	6.	32.		48.	.58	1.16	245.	
Diesel $	740.	351.	30.	36.	48.	82.	74.	2.	.95	.30	74.	
Spares $	4715.	2355.	388.	908.	346.	586.	46.	320.	10.78	8.42	4715.	
P2 $	5700.	2760.	520.	1100.	400.	700.	120.	370.	12.31	9.88	5700.	
Primary Tng	1	1										
Secondary Tng					1						1	
Limited Tng												

TABLE II-1

Maint Z days $X_{101,88} = 9$, avoid negative deviation

Convert primary, secondary and restricted training to X, Y, Z days.
Primary training

(Training activity days to primary training) = (X time to primary training)

- (X time to primary training) + (training activity days to primary training) = 0.

$- X_{88,89} + X_{88,95} + X_{88,96} = 0$

Secondary

(Training activity days to secondary training) = (X days to secondary training) + (Y days to secondary training)

- (X days to secondary training) - (Y days to secondary training) + (training activity days to secondary training) = 0

$- X_{89,90} - X_{89,92} + X_{89,99} + X_{89,105} = 0$

Limited Training

- (X days to limited training) - (Y days to limited training) - (Z days to limited training) + (training activity days to limited training = 0

$- X_{90,91} - X_{90,93} - X_{90,106} + X_{90,106} = 0$

Sum all X, Y, and Z days into a balance total.

X days

- (Total X days) + (X days/maint range) + (X days/primary Training + (X days/secondary training)+(X days limited training)+(X days SQT prep =

$- X_{91,82} + X_{91,86} + X_{91,89} + X_{91,99} + X_{91,91} + X_{91,108} = 0$

Y days

- (Total Y days) + (Y days/maintenance) + (Y days/secondary training)

- (Y days/limited training) + (Y days/SQT prep) = 0

- $X_{92,83} + X_{92,87} + X_{92,92} + X_{92,93} + X_{92,109} = 0$

Z days

- (Total Z days) + (Z days/maintenance) + (Z days/limited training) + (Z days/SQT prep) = 0
- $X_{93,84} + X_{93,88} + X_{93,94} + X_{93,110} = 0$

The availability of equipment for training depends on the amount of equipment on hand, the average percent of time that an item of that type is operationally available, and the number of days during which training could be conducted. This section of the BTM represents nominal numbers showing a notional availability rate of 80%, a 253-day year and a full TOE complement of equipment. For each item of equipment chosen:

Input total number on hand.

$$X_{ij} = b_i \qquad \text{avoid positive deviation}$$

$i = 123,130$
$j = 74,81$

Multiply the total number on hand by the equipment-days factor and balance available equipment days against requirements for equipment days.

Equipment days factor = (average availability rate) (possible training days)

$$= (.80)\ (253) \qquad \text{(QL4)}$$

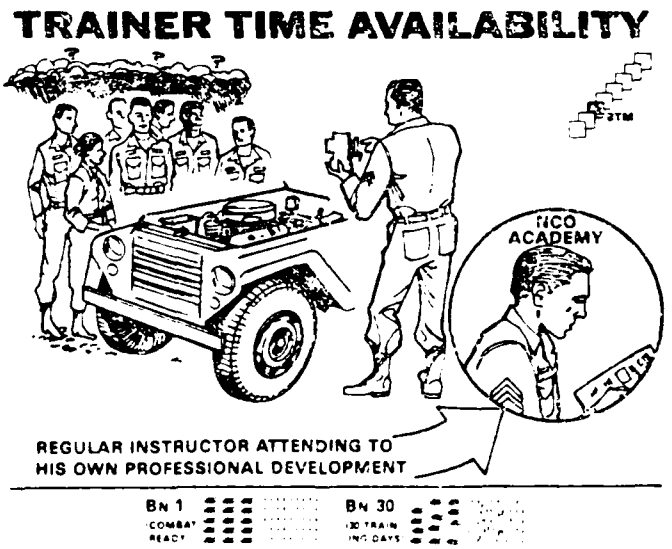
$$= 202$$

$$-202\ X_{i,j} + \sum_{j=95}^{106} (a_{ij}\ X_{ij}) = 0$$

for $i = 115,122$

If the equipment used in a given computer run is less than or equal to the equipment on hand, it is an indication that the unit theoretically has sufficient equipment of the type in question to meet the total year's requirement for equipment days. This is a dangerous indicator, however, since there is no assurance that there will be sufficient equipment to conduct training on any specific day. As an example, if there were one item of a certain type of equipment on hand, there would be 202 possible equipment days, because that item would be available on 80% of the 253 possible training days. The BTM would satisfy a demand for 100 such items of equipment during one day's training even though there could not actually be more than one item available for any given day.

There is a direct correlation between the treatment of equipment and personnel in the BTM. Trainer man-days are drawn from a pool of officer and NCO man-days to fill trainer man-day requirements.



The requirements for trainers are based on two assumptions which seem reasonable but which are not backed by empirical data. First, fully effective multiechelon integrated training requires the presence and active participation of 50% of the chain of command. Second, each one day of instruction requires 2 man-days of preparation. To determine the man-days requirements for a given training activity it is necessary to multiply the number of days of training by one half the TOE chain-of-command strength and add 2 man-days preparation time for each day of instruction. Thus, a 4 day Mechanized Infantry company level battle drill would require: (QL4)

$$(.5)(4)(162) + (4)(2) = 324 \text{ plus } 8 = 332 \text{ instructor man-days.}$$

Although the conduct of the ARTS sensitivity analysis required that the number of personnel present for training be held constant, at least during X and Y days, it is to be expected that the actual present-for-training strength will vary markedly in a given unit. The BTM has, therefore, a capability to differentiate among the various days.

To use the personnel section, the assigned strength in officers, NCO's, E1-E4 is:

Officers	$X_{112,62} = b_{112}$; avoid positive deviation from b.
NCO's	$X_{113,63} = b_{113}$
E1-E-4	$X_{114,64} = b_{114}$

Calculate and balance the number present for training from each category during X, Y, and Z time. If a represents the % present for training,

Officer X days $- (a_{103,62} \quad X_{103,62}) + X_{103,65} = 0$

Officer Y days $- (a_{106,62} \quad X_{106,62}) + X_{106,68} = 0$

Officer Z days $- \quad a_{109,62} \quad X_{109,71}) + X_{109,71} = 0$

NCO X days $- (a_{104,23} \quad X_{104,63}) + X_{104,66} = 0$

NCO Y days $- (a_{107,63} \quad X_{107,63}) + X_{107,69} = 0$

NCO Z days $- (a_{110,63} \quad X_{110,63}) + X_{110,72} = 0$

E1 - E4 $- (a_{105,64} \quad X_{105,64}) + X_{105,67} = 0$

E1 - E4 $- (a_{108,64} \quad X_{108,64}) + X_{108,70} = 0$

Convert officers and NCO's per day to officer and NCO man-days by multiplying the availability rate per day by the number of possible days, and incorporating into one equation to match available trainer man-days with requirements for trainer man-days.

$$- 83 (X_{102,64} + X_{102,65}) - 85 (X_{102,68} + X_{102,69} + X_{102,71} + X_{102,72}) + \sum_{j=1}^{63} (a_{102,j} X_{102,j}) + (a_{102,111} X_{102,111}) + (a_{102,112} X_{102,112}) = 0$$

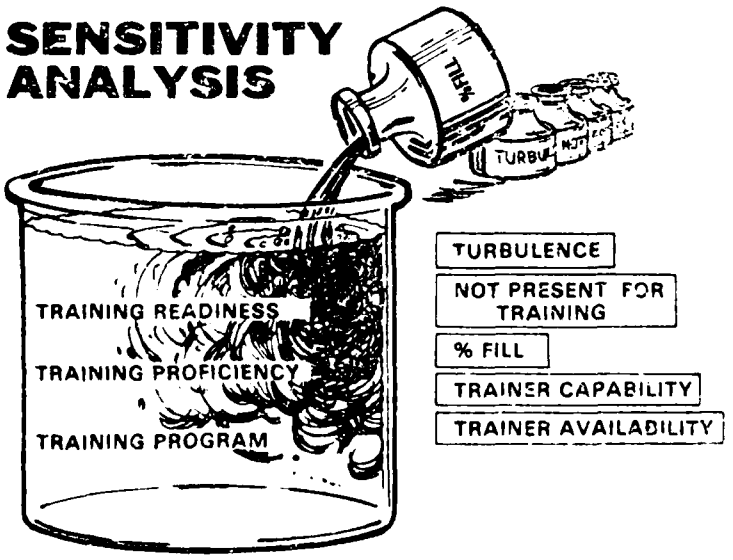
The integration of available E1-E4 into SQT preparation was discussed in the section entitled training program. SQT preparation is the only section in which E1-E4 strength is treated in detail in the BTM. A similar approach could be used for any activity in which complete participation is essential.

Treatment of personnel suffers from the same shortcomings as does equipment. The model may indicate that there are sufficient trainers for a complete year without highlighting the fact that there may not be sufficient trainers for any given day.

Training area/facilities refers to the land or structures essential to the conduct of training, available for sufficient time to conduct training, and free of physical or regulatory restrictions which would prevent suitable training. This subject has not been addressed in the BTM to date because of the press of time. Further, training area availability is contingent on an extremely complex combination of unit training priorities, training schedules, and training area adequacy. Training area/facilities is proposed as a high priority matter for further BTM development.

Systems Policies

The Army has a number of personnel, logistic and budget policies which impact directly on the unit's ability to conduct training. As with training readiness, there are no specific equations in the BTM which address these policies. The unit's ability to complete the 95% training program to become combat ready under various policy effects is analyzed by varying factors or relationships within the BTM rather than by adding new equations.



Several policies or conditions have been the subject of ARTS' sensitivity analysis to date. The primary sources of input data regarding the effects of the policies were the Battalion Training Survey and the "Best Battalion" Costing Program. The key policies and conditions are described below. The results of the sensitivity analysis are included in Chapter IV.

Turbulence is the total effect of all conditions which shift personnel from one duty position to another, and reduce unit retention of trained personnel. Turbulence may be caused by local policies and requirements or may be system induced, and, as a result, be totally out of unit control. Changes in duty position consist of actual movement from one job or position to another. These changes are primarily caused by transfers in and out of the unit and career progression. For the BTM, there has been a simplifying assumption that the rate for changes in duty position is equal to twice the unit turnover rate. This assumption is based on data outlined in the Total Tank Systems Study and the ARI sponsored turbulence test at Fort Ord.

Personnel fill is the percentage of the MTOE authorized strength who are actually assigned to a unit. This factor is affected by manning levels, reassignment policies, and personnel management.

Personnel not present for training are those members of a unit who should benefit from training periods but who are absent due to leave, unauthorized absence, TDY schools, appointments, details, special duty and other requirements. It is expressed as a percentage of the assigned strength.

Trainer grade substitution is a direct result of incomplete personnel fill in the leadership grades or fill of TOE positions by personnel who do not hold the appropriate rank. Lower grade personnel are normally less experienced and/or less qualified. Trainer grade substitution is expected to affect the quality of training integration which can be conducted and the length of time required to conduct training to a given standard.

Less qualified personnel (those with an Armed Forces Qualification Test score of 30 or below) can be expected to have an effect on the unit's training program. The Battalion Training Survey indicates that there is strong belief that, for most skills, such personnel require longer training time and more frequent re-training than do higher mental category personnel.

Individual skills not taught in AIT must be taught in the unit. Since it takes longer to learn something for the first time than to re-learn it, a task deleted from AIT places a greater training burden on the unit. Changes in AIT curriculum then, have a direct effect on the unit's ability to train to standard.

Chapter III

TECHNICAL DESCRIPTION

This chapter presents a technical description of the Battalion Training Model. It describes the analytical techniques used to simulate the Army Training System through formulation of training parameter equations and the linkage of these equations using matrix algebra. The chapter concludes with a discussion of goal programming techniques, the specifics of the actual goal program used in the BTM, and a technical description of several of the computer runs made to date.

Battalion Training Model Formulation

The Battalion Training Model has been formulated in a three-step process. First, parameters representing the training environment are aggregated in a matrix format which can be translated into algebraic equations that simulate portions of the training environment. When matrices and equations representing all aspects of the training environment are formed, they are linked together by tying the output function of one to the input function of another until the sum of all matrices are formulated into a dynamic and interacting simulation. Goal programming is applied to this simulation, allowing goals for any combination of the equations to be optimized simultaneously. This procedure is addressed step by step below.

Step 1 - Technique

Express fundamental training parameters in a matrix format that can be translated into equations. Identify specific goals for each equation. (See Figure III-1.)

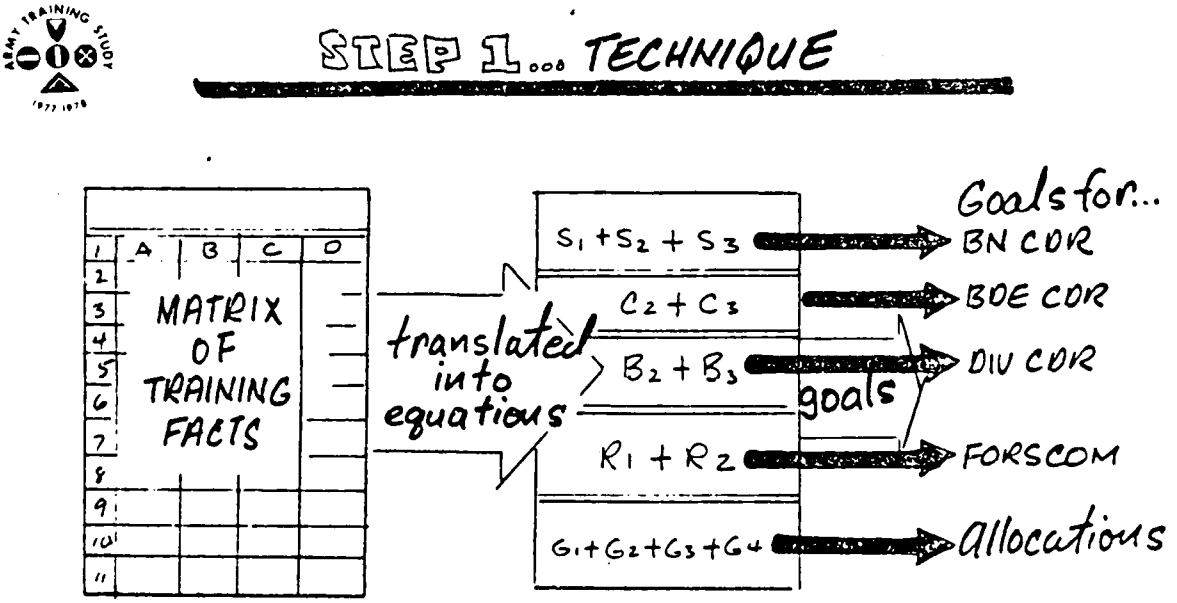


Figure III-1

Step 2 - Technique

Link together all training parameter matrices. To accomplish this, use outputs from one matrix as inputs to the following matrix. (See Figure III-2).

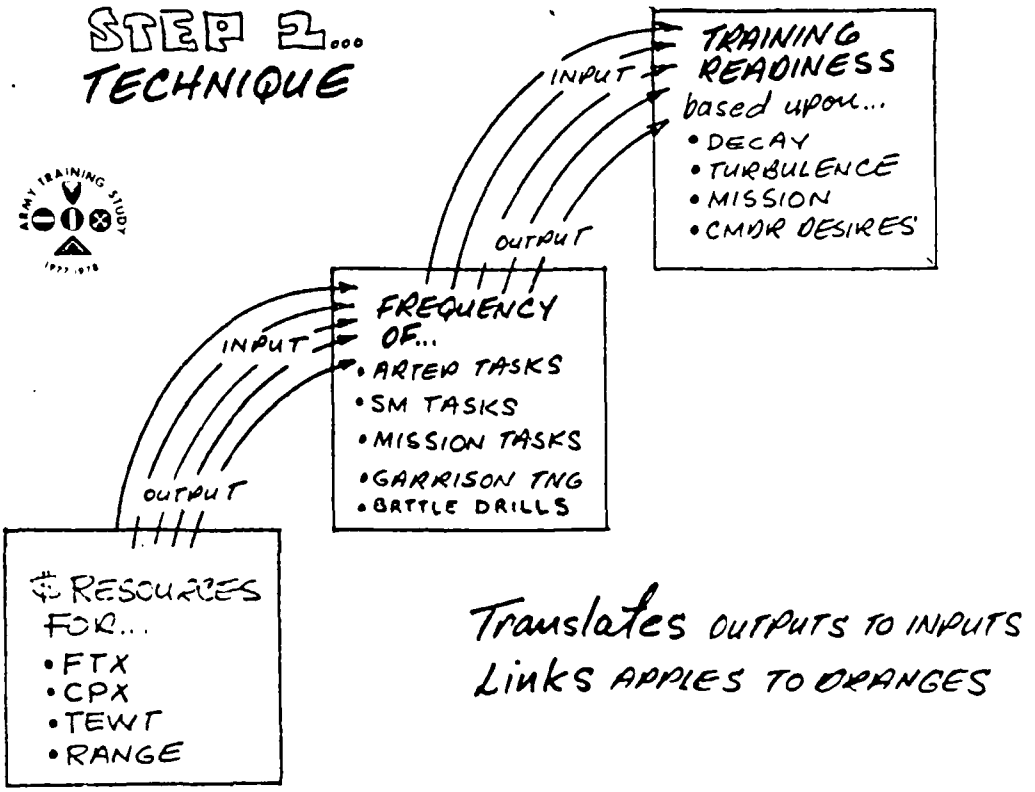


Figure III-2

Step 3 - Technique

Continue process of linking matrices based on the following rationale. (See Figure III-3)

- Training functional relationships can be described through this mathematical process.
- Well-planned matrices can be expressed as equations.
- These equations can be solved to optimize goals.

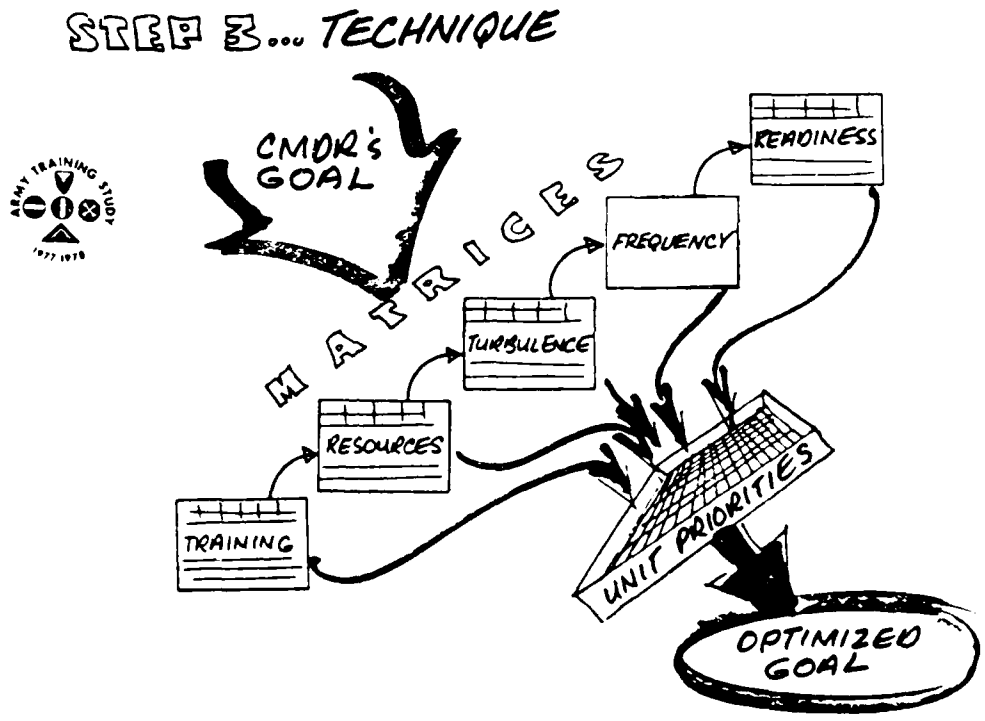


Figure III-3

The complete model is shown in Figures III-4 and III-5. Figure III-4 presents a broad overview which depicts the manner in which the various portions of the model address the ARTS guidance. Figure III-5 is a more detailed schematic which presents the general nature of the BTM matrices and their interrelationships.

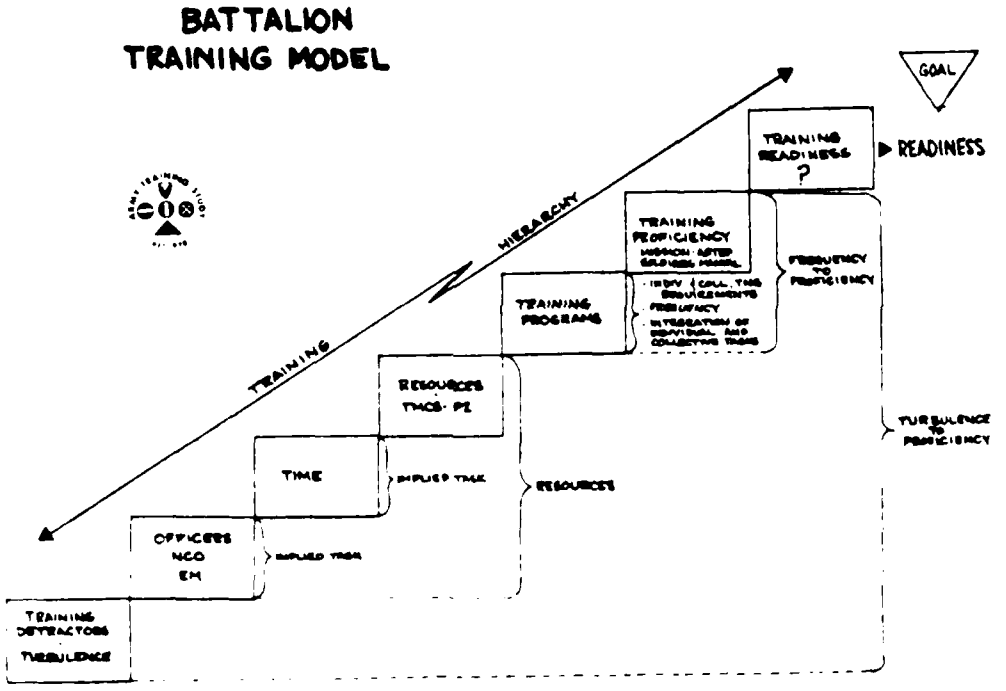


Figure III-4

BATTALION TRAINING MODEL

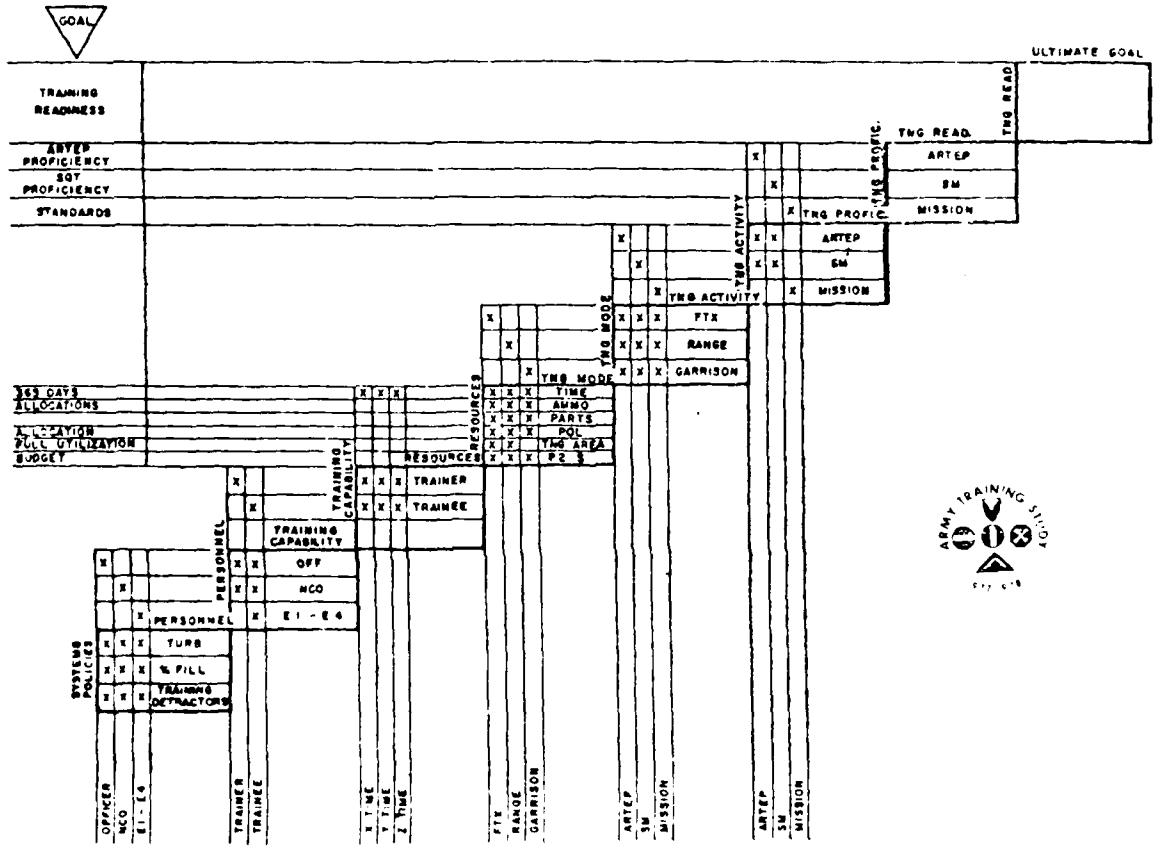


Figure III-5

Goal Programming Concepts[1]

Battalion training objectives vary according to unit locations, commander, philosophy of management, and particular environmental conditions of the home station. There is no single universal training goal for all battalions. In today's dynamic Army environment, maximum training proficiency is not the only objective. Frequently, commanders must place great emphasis on mission responsibilities, maintenance, troop tests, post responsibilities, etc.

Since commanders have multiple conflicting objectives to achieve, their decision criteria should also be multidimensional. This implies that when a decision involves multiple goals, any quantitative technique used should be capable of handling multiple decision criteria.

The linear programming technique used in the Training Management Control System (TMCS) has been applied quite extensively and relatively successfully to various decision problems but has a serious limitation; it does not adequately cope with multiple goals. The primary difficulty with linear programming is not its inability to reflect complex reality. Rather, it lies in the unidimensionality of the objective function, which requires cost or profit information that is almost impossible to obtain. For example, in a training scheduling problem, it is not easy to determine costs associated with the fluctuations in NCO levels, turbulence, mission standards, mobilization time, integrated training, soldier's manual training, etc. Linear programming is not generally suitable for such decision analysis.

To overcome the unidimensionality of the objective function required in linear programming, efforts have been made to convert various goals, costs, or value measures into one criterion - utility. If this process could be effectively performed, the limitations of linear programming would undoubtedly be reduced. However, exact measurement of utility is not a simple matter, and there is presently no effective methodology to develop a utility function for an individual, much less a group of people. Hence, decision making through linaer programming leaves much to be desired.

To analyze the concept of goal programming, the concept of linear programming must first be understood. The basic requirements of linear programming are: the choice variables constituting the decision system must have one unit of measure and be linear; there must be a set of constraints, or limited resources; and there must be an objective to achieve. This objective must be expressed as a linear function composed of the decision variables.

[1]Extracted and paraphrased from Goal Programming for Decision Analysis, Sang M. Lee, pp 18-32, Auerbach Publishers, Inc., Philadelphia, 1972.

In the usual linear programming model, the objective is to maximize or minimize the objective criterion by meeting some constraint or goal. The constraint is expressed by some linear combination of decision variables that correspond to the inputs and/or outputs of the system under consideration.

In the optimization of any linear system, it is desirable to utilize any idle resources to the extent that they still contribute to the optimality of the objective function. This is precisely the linear programming procedure. Idle resources are utilized until they no longer exist or no longer contribute to the achievement of the objective. At this point, the optimum is achieved.

Linear programming requires unidimensionality in the objective function. The commander must strive to do one thing and one thing only, i.e., either maximize training, minimize costs, or perform some other objective criterion. Yet, many commanders' decisions involve conflicting objectives. Furthermore, these other objectives may use entirely different criteria from that of the objective function of the linear programming model. Even under normal circumstances the commander could end up with another, more complex, programming problem in his mind.

> It is important to realize in trying to construct models of real-life situations, that life seldom, if ever, presents a clearly defined linear programming problem, and that simplification and neglect of certain characteristics of reality are as necessary in the application of linear programming as they are in the use of any scientific tool in problem solving.[2]

The goal-programming approach is one way in which some of these difficulties can be alleviated. As a modification and extension of linear programming, it allows a simultaneous solution of a system of complex objectives rather than a single objective. In other words, goal programming is a technique that is capable of handling decision problems that deal with a single goal with multiple subgoals, as well as problems with multiple goals, each having multiple subgoals. In addition, the objective function of a goal programming model may be composed of mixed units of measure such as time, dollars, and proficiency scores.

Often, training goals are in conflict or are achievable only at the expense of other goals. Thus, the solution of the problem requires an establishment of priorities among these incompatible goals so that the lower-order goals are considered only after the higher-order goals are satisfied or have reached the point beyond which no further improvements are desired or feasible.

[2]George B. Dantzig, Linear Programming and Extensions, Princeton, NJ, Princeton University Press, 1963.

How is an objective function to be determined and expressed when there exist multiple, mixed, and conflicting goals? A simple answer might be to suggest an objective function composed of multiple goals. This is the essence of goal programming. The true value of goal programming is the solution of problems involving multiple, conflicting goals according to the commander's priority structure. In general, a goal programming model performs three types of analysis: (1) it determines the input requirements to achieve a set of goals; (2) it determines the degree of attainment of defined goals with given resources; and (3) it provides the optimum solution under the varying inputs and goal structures. The most important ad- vantage of goal programming is its great flexibility, which allows simulation with numerous variations of constraints and goal priorities.

Every quantitive technique has some limitations. Some of these are inherent to all quantitative tools and some are attributable to the particular characteristics of technique. The most important limitation of goal programming belongs to the first category. The goal programming model provides the best solution under the given set of constraints and priority structure. Therefore, if the goal program does not reflect the actual situation and the decision-maker's priorities, the solution will not be the optimum for the battalion. For an effective application of goal programming--and for that matter of all mathematical techniques--a clear understanding of the assumptions and limitations of the technique is a prerequisite.

Goal programming can be applied to almost unlimited managerial and administrative decision areas. The following three paragraphs describe the most readily applicable areas of goal programming.

One of the basic decision problems is the optimum allocation of scarce resources. Let us assume that there are n different input resources that are limited to certain quantities and there are m different types of outputs that result from various combinations of the resources. The decision problem is to analyze the optimum combination of input resources to achieve certain goals set for outputs so that the total goal attainment can be maximized for the organization. A goal programming approach has been applied to the resource allocation problems in nonprofit institutions similar to the Army. This approach analyzes the resource requirements and actual allocation in order to achieve the goals of the organization which cannot be expressed in profit and loss terms. Also, goal programming has been applied to the sales effort allocation problem in the marketing area.

Many decision problems involve some degree of planning and/or scheduling. In order to achieve certain goals in the future, decisions must be made concerning present and future actions to be taken. To accomplish desired outputs, the optimum combination of inputs in certain periods must be

identified. These inputs may include manpower, materials, time, production capacity, technology, etc. Many problems, such as production scheduling, location determination, financial planning, personnel planning, marketing strategy planning, etc., can be analyzed by goal programming. It has also been applied to media planning, manpower planning, aggregate production scheduling, financial planning, location determination, etc.

For government agencies and nonprofit organizations, the basic decision problem involves the assignment of priorities to various goals and development of programs to achieve these goals. Such a decision process constitutes the policy analysis of the organization. Through the application of goal programming, the organization is able to ascertain the soundness of its policies, the input requirements for achievement of set goals, and the degree of goal attainment possible with the given resources. This review and evaluation process is an integral part of policy analysis. Therefore, goal programming is particularly well-suited for decision analysis in public and nonprofit organizations.

The selection of the correct mathematical tool required a knowledge of the training planning model and training data sources. The availability of data in some measure precluded the use of some simpler mathematical models. For example, linear programming could be used if a common agreement could be found on the value of diverse resource competitors such as an ARTEP mission training day versus a day of athletics and recreation versus M113 APC operational availability. The universal application of the Battalion Training Model is possible because of its ability to reconcile such diverse relationships. It derives this desirable feature from its use of goal programming.

Essentially, any mathematical tool that could embrace multiechelon criteria, with conflicting demands for resources would have been applicable. The study considered the following possible techniques:

Linear Programs (Single objective, linear models)

Nonlinear Programs (Single objective, nonlinear model)

Integer Programs (Subset of linear programs restricted to whole number answers)

Linear Decision Rules (Heuristic linear models with variations on one parameter)

Multiple Objective Linear Decision Models (Goal programming)

Multiple Objective Nonlinear Models (complex calculus type solutions)

The consequences and expediency of any of the models were weighed in terms of the issues involved in the analysis at hand. For example, the

world is generally understood as being nonlinear, but nonlinear techniques are very difficult to understand and use. Linear models are generally considered good approximations of reality if the nonlinear function remains relatively constant in the period under study. For purposes of training modeling, linearity was considered a reasonable assumption. In some cases, it was possible to convert the effects of nonlinear functions (proficiency decay) to linear parameters (frequency of required training). The final result was the selection of goal programming.

The BTM is block diagrammed below:

DATA INPUT

BTM MODEL
FORMULATION

GOAL
PROGRAM
ALGORITHM

OUTPUT
REPORTS

The data formulation is discussed in chapters II and IV. Similarly, BTM model formulation was discussed in chapter II. This section will highlight technical features that are not easily available in texts on goal programming. The texts on goal programming noted below are recommended for specific technical concepts.

BTM Algorithm

The algorithm used in the BTM has been adapted from a Concepts Analysis Agency (CAA) goal programming formulation.* This formulation is mathematically optimal. Two books** have been written, establishing the basic formulation. The fundamental computing technique is the Simplex method. Goal programming uses a modification of Simplex to account for multiple objectives. Details of the mathematical process are described in the two goal programming books.

The general format of the BTM consists of multiple objective functions and an achievement function. Each objective function is characterized as:

*This formulation was developed at the Concepts Analysis Agency by LTC Richard Nugent during the 1976-1977 time frame.

**Goal Programming for Decision Analysis, Sang M. Lee, Virginia Polytechnic Institute, Auerbach Publishers, Inc., Philadelphia, 1972.

**Goal Programming and Extensions, James P. Ignizio, Pennsylvania State University, Lexington Books, DC Health and Company, Lexington, Massachusetts, 1976.

Objective X = Goal

or to allow for exceeding or falling short of the goal;

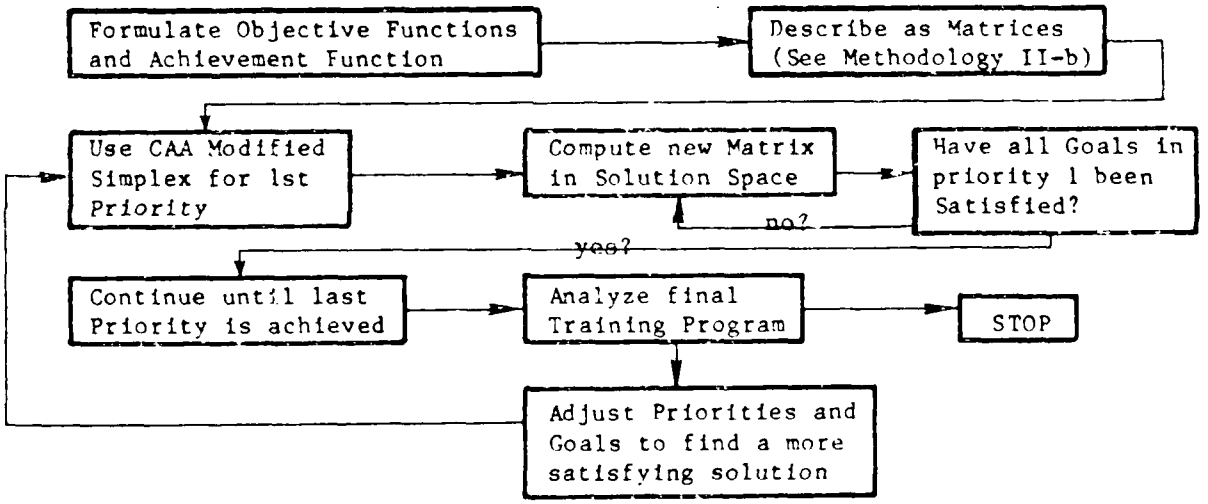
(Objective X) + (Negative Deviations) - (Positive Deviations) = Goal

Having all the objective functions in this format allows the formulation of the achievement function. The achievement function is stated:

> Minimize selected positive and/or negative deviations from the objective functions in an order of priority selected by the training manager.

This format allows the use of standard multiple objective Simplex solutions which are iterative optimality-seeking processes.

A block diagram of this process appears below: (See annex M and annex N)



This solution technique has several features which should be highlighted.

The purpose of the achievement function is to minimize the total deviation from the goals of the objective function.

The unit of measure in the achievement function can be multidimensional among priorities. This feature allows many conflicting concepts to be considered simultaneously without having to assign the artificial costs or values required in linear programming.

The Simplex optimality criterion is expressed as a matrix rather than a one-dimensional vector. This multidimensional feature has led some

authors to state that linear programming is actually a special case of goal programming.

In using the multidimensional Simplex method, the criterion used to determine the optimum column is the rate of contribution each training factor makes toward achieving the most critical training goal. The key row is selected by finding the most efficient contributor to goal achievement. The standard Simplex technique is then used to transform the matrix for consideration in the next iteration. This process continues until the best training program has been achieved.

BTM Computer Program

The computer program consists of input cards, the optimal seeking algorithm and output reports. The main flow chart is presented for the analyst, together with detailed program listings with ample comment cards in Annexes M and N.

Input Card Data

Program Card: this card requires information on the size of the problem to be processed.

- Number of rows or equation (130 Max)
- Number of priorities used (20 Max)
- Number of variables (130 Max)
- Number of deviations in achievement function
- Report printing options
- Maximum iterations

Header Card: for titling the run and adding any comments.

Coefficient Data Card: one card is used to denote the row, column, and value of each coefficient. Coefficients are described in chapter II. (Max number is 130 x 130 = 16,900).

Goal Card: this is the value on the righthand side of the equations in chapter II (Max = 130). The row and value is listed for each card.

Priority Structure Card: this card establishes the number of terms in the achievement function. The priority, row, positive, and negative deviation and weight is placed on each card. (Max = 260).

Name Cards: cards are provided to list a 12-letter acronym for priority titles, variable names and objective goal names. (Max = 280).

Run Description General Overview

The BTM used the results of the Battalion Training Survey and "Best Battalion" Costing Program data to formulate a midresolution analysis of annual training programs incorporating battle drills. The TEA 78 data is being used to confirm and/or replace survey data as it becomes available. Confidence in the data is strong from a statistical viewpoint and believable from a common sense perspective. This data should continue to be improved in the years 1979 through 1985 to refine the Army's procedures for managing training resources.

The BTM was processed through a series of stages to incorporate the dynamics of the integration process and the battle drill concept. The integration process is complex since it occurs in several dimensions of the training management process. To facilitate the transition from individual tasks to collective tasks to battle drills to ARTEP missions to training packages, three intermediate stages were developed:

1. Integrate individual and collective tasks into battle drills.

2. Integrate ARTEP missions into battle drills and other ARTEP missions.

3. Merge stage 1 and stage 2 into an optimal training package and analyze in the main BTM program.

The development of stage 1 and stage 2 above had several implications. First, the integration of individual and collective tasks must consider task overlap. The degree of task overlap was developed in the design of the Battalion Training Survey. Consequently, the data results of the survey were used to accomplish task integration. Second, the assumption was made that the integration was constant throughout the planned year. This assumption can only be valid if NCOs of correct grade and education are available to conduct the training. Third, initial baseline considered ideal resource availability, hardward operational availability, manpower fill, ammunition and training area availability. This allowed an "uncluttered" view of the true training requirement. Fourth, modifications to this "best-case" training environment were introduced in the main run of the BTM. These sensitivity analyses are discussed in chapter IV.

A Typical Run

The standard computer outputs are best explained using one of the early runs of the BTM. Presented below for purposes of explaining output format is a preliminary analysis of integration of collective and individual tasks into battle drills.

The model used in this stage assumed that collective tasks were allocated to battle drills as primary and secondary tasks with other

tasks being integrated at a lower level of emphasis. This was accomplished assigning a credit of one training frequency to primary tasks and a credit equivalent to one-half training frequency to secondary tasks. Integrated tasks were given frequency credits ranging from one-tenth of a frequency to four-tenths of a frequency. This has the very real effect of indicating how much task training is received in a single battle drill as well as accounting for the cumulative benefits of an annual program. The individual tasks were treated in a similar fashion. Battle drills were separated into two groups, company and platoon/squad. This was developed to allow analysis of the two levels and to accommodate the wide range of task times and frequencies recommended by the Battalion Training Survey.

A special group of high decay individual tasks was developed using the acronym "SEP IND TNG" for individual integration that needed separate identification to preclude being los in more general data. These were NBC, live-fire, individual battle position/hold, individual movement, individual communications and individual reconnaissance and security. The model was formatted to use five priorities.

Priority 1. Develop an annual integrated training program that incorporated all the collective task frequencies recommended as mean values in the Battalion Training Survey.

Priority 2. Develop an annual training program that reflected a quarterly battle drill program. (Quarterly may not be the best frequency. Another sensitivity run was made to examine this question. Analysis of this run indicates that some battle drills may be conducted with annual frequencies of three or two).

Priority 3. Develop and annual training program that integrates all the individual task frequencies recommended as mean values in the Battalion Training Survey.

Priority 4. Complete minimum required training of separate individual tasks as recommended in the Battalion Training Survey.

Priority 5. Conduct the annual training program in 720 hours. (Since total hours equal 720, this can represent a 72-day program of 10 hours training per day or 90 days with 8 hours of training). The weight given to each task was equal. Because the time factor was allowed to change if an optional program was not computed in 720 hours, weighting was not important. Future runs will dictate time limits that must be satisfied because of other management decisions. At that point, weighting of tasks will play a key role in determining which tasks are to be decremented in frequency.

Descripton of Computer Run 001

The computer output of run 001 contains a comprehensive display of training management data. This section will describe the data that is calculated. All referenced samples of computer listings are at the end of this chapter.

Part 1. Detailed computer instructions that are the FORTRAN program used in the BTM. (Annex N)

Part 2. Detailed input data for this particular run. (Sample 1)

Part 3. Detailed annual training program that was sequentially developed by the computer seeking an optional solution to the five priorities. (Detailed explanation below - Sample 2)

Part 4. Output reformatted for general use by managers. (This can be tailored to satisfy specific needs as we gain experience in using these formats.) (Sample 3)

Detailed Annual Training Programs (Sample 2A thru 2D)

This section has a standard formatting as indicated at interation 0. (Sample 2A)

The column titled "Basic Variable" is the mathematical achievement function. Under the subcolumn "Variable" is the Negative (=N) or Positive (=P) deviation from the goal previously established in the definition of priorities. Under the "Value" subcolumn is the frequency goal for collective or individual tasks. This column is initially assigned from top to bottom in order of the Battalion Training Survey sequence of collective tasks. This column is only of interest to the computer programmer.

The column titled "Objectives" is of key interest. In this run it is in fact an annual training program. The computer starts with the frequency goal and attempts to eliminate negative deviations. The frequencies allocated in the solution are listed under "Achieved" and "Computed." Each represents a particular task with a frequency that must be achieved. Only row 71 is different. This is the time goal. Time builds in iteration after iteration until 720 hours is used at iteration 20 (Sample 2B). Not all goals of task frequency have been met. Scan the Neg-Dev column to see the shortfalls. But, overtraining is already being done on some tasks (see POS DEV column). We need to cut back on overtraining to force more training programs under the 720-hour limit. This continues through iteration 90 (Sample 2C) where no more solutions for 720 hours are reasonable. The computer begins to add time until it

finds an optimal solution at iteration 111 (Sample 20). It is now known that the training program will require 1742 hours (Variations to reduce this were conducted in subsequent analysis).

The column titled "Achievement Function" is a counting mechanism to see how many frequencies by priority must be accommodated. At iteration 0, Priority 1 (Collective tasks) has a total of 200 frequencies to be programmed in the training goals. Priority 2 thru Priority 4 are similar. Priority 5 was designed to indicate time increases from one program (Iteration) to the next. An optimal solution would consist of all zeroes in the "value" subcolumns.

Standard BTM Report Output (Sample 3)

This indicates the proceeding data reformatted with acronym titles. The first column is the priority values from the objective function. The second column is the annual battle drill frequencies for a quarterly program. Separate individual tasks are also listed. The column titled "Objectives" is a grouping of detailed collective and individual tasks. (C = Company, P = Platoon/Squad, I = Individual)

Sample Math Model - Run #001

Definitions:

C_{ij} = Company level collective task (i) frequency achieved in company battle drill CBj

P_{ij} = Platoon/Squad level collective task (i) frequency achieved in platoon/squad battle drill PBj

IC_{ij} & IP_{ij} = Individual level task (i) frequency achieved in company (CBj) and platoon/squad (PBj) battle drill

SI_{ij} = Separate individual task (i) achieved in (PBj) platoon/squad battle drill

F_{ij} = Live fire (i) frequency achieved in (PBj) platoon/squad battle drill

T_j = Time to conduct 1.0 frequency of a collective or individual task as computed in Battalion Training Survey (mean value)

CB_j = Frequency of company battle drills of task (j) (Move, Shoot, etc.)

PB_j = Frequency of platoon/squad battle drills of task (j)

P1-P5 = Priority 1 through priority 5.

N_i = Negative deviations of frequency of collective task (i), battledrill (i), individual task (i), separate individual task (i), and time (i).

$$\text{MIN} \quad P1 \sum_i N_i \text{ Collective} + P2 \sum_i N_i \text{ Battle Drill} +$$

$$P3 \sum_i N_i \text{ IND} + P4 \sum_i N_i \text{ SEP} + P5 \sum_i P_i \text{ TIME}$$

ST: $\sum_j C_{ij} CB_j \geq$ (SURVEY USAREUR COMPANY MEAN FREQ)i

$\sum_j P_{ij} PB_j \geq$ (SURVEY USAREUR PLT/SQD MEAN FREQ)i

$\sum_j (IC_{ij} \text{ \& } IP_{ij}) B_j \geq$ (SURVEY USAREUR IND CO PLT/SQD MEAN FREQ)i

$\sum_{ij} PB_{ij} \geq$ (QUARTERLY BATTLE DRILL)i

$\sum_j SI_{ij} PB_j \geq$ (SURVEY USAREUR IND MEAN FREQ)i

$\sum_j F_{ij} PB_{ij} \geq$ (SURVEY USAREUR LIVE FIRE MEAN FREQ)i

$\sum_j T_{ij} (CB_j \text{ \& } PB_j) \leq$ 720 HOURS (90 Days X 8 Hrs. Day)

GOAL PROGRAMMING
SUMMARY OF INPUT INFORMATION

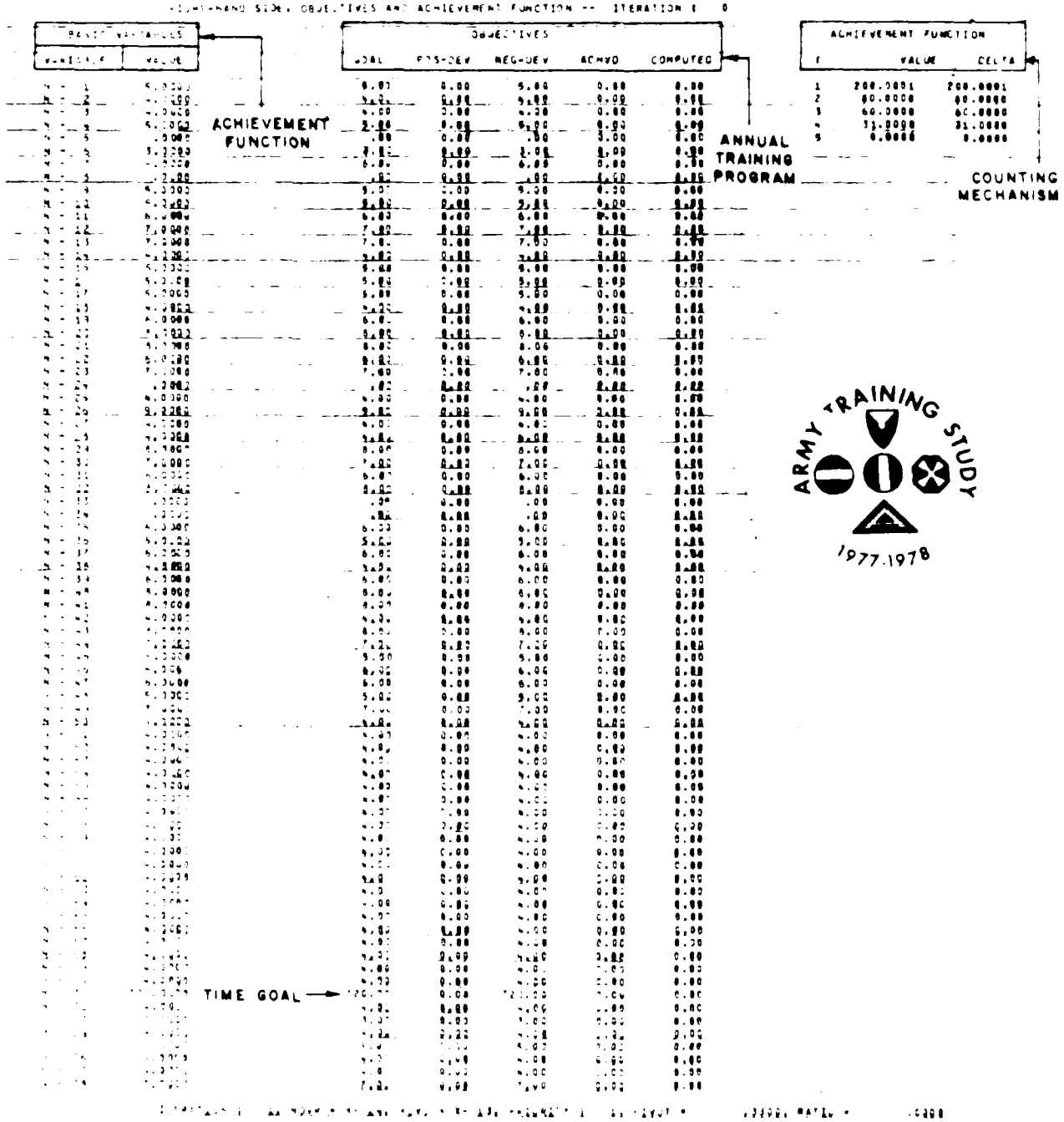
NUMBER OF ROWS	78
NUMBER OF DECISION VARIABLES	27
TOTAL NUMBER OF COLUMNS	105
NUMBER OF PRIORITIES	5
NUMBER OF TERMS IN ACHIEVEMENT FUNCTION	78
WHITE-OUT SWITCH	0
DIAGNOSTIC SWITCH	-1
[illegible] (FIX)	7
MAXIMUM NUMBER OF ITERATIONS	500

PRIORITY STRUCTURE

ROW	PRIORITY	WEIGHT
1	1	1.00
2	1	1.00
3	1	1.00
4	1	1.00
5	1	1.00
6	1	1.00
7	1	1.00
8	1	1.00
9	1	1.00
10	1	1.00
11	1	1.00
12	1	1.00
13	1	1.00
14	1	1.00
15	1	1.00
16	1	1.00
17	1	1.00
18	1	1.00
19	1	1.00
20	1	1.00
21	1	1.00
22	1	1.00
23	1	1.00
24	1	1.00
25	1	1.00
26	1	1.00
27	1	1.00
28	1	1.00
29	1	1.00
30	1	1.00
31	1	1.00
32	1	1.00
33	1	1.00
34	1	1.00
35	1	1.00
36	1	1.00
37	1	1.00
38	1	1.00
39	1	1.00

ARMY TRAINING STUDY
1977-1978

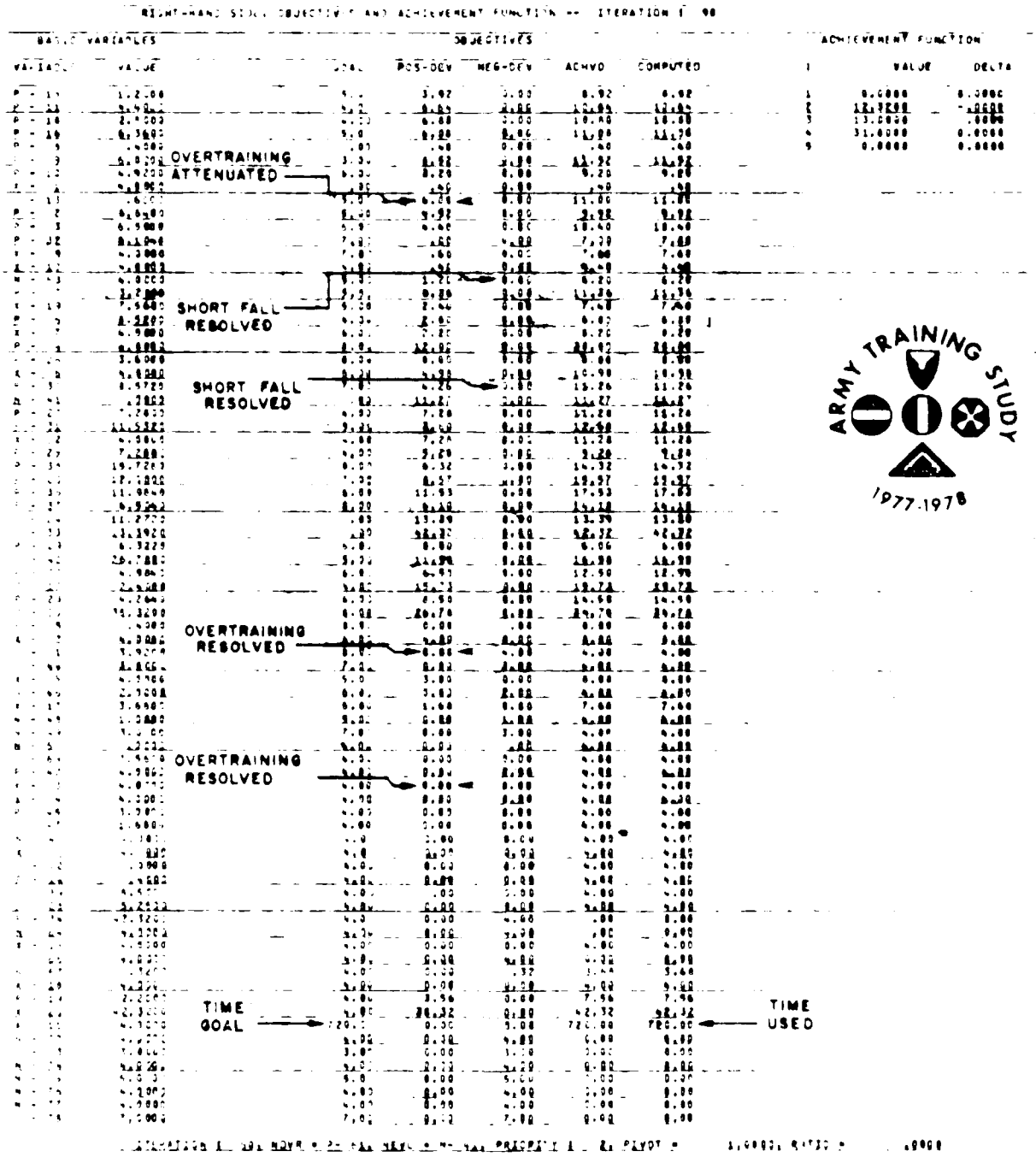
SAMPLE I


ACHIEVEMENT FUNCTION
ANNUAL TRAINING PROGRAM
COUNTING MECHANISM
TIME GOAL
OBJECTIVES
ACHIEVEMENT FUNCTION
ARMY TRAINING STUDY
1977-1978

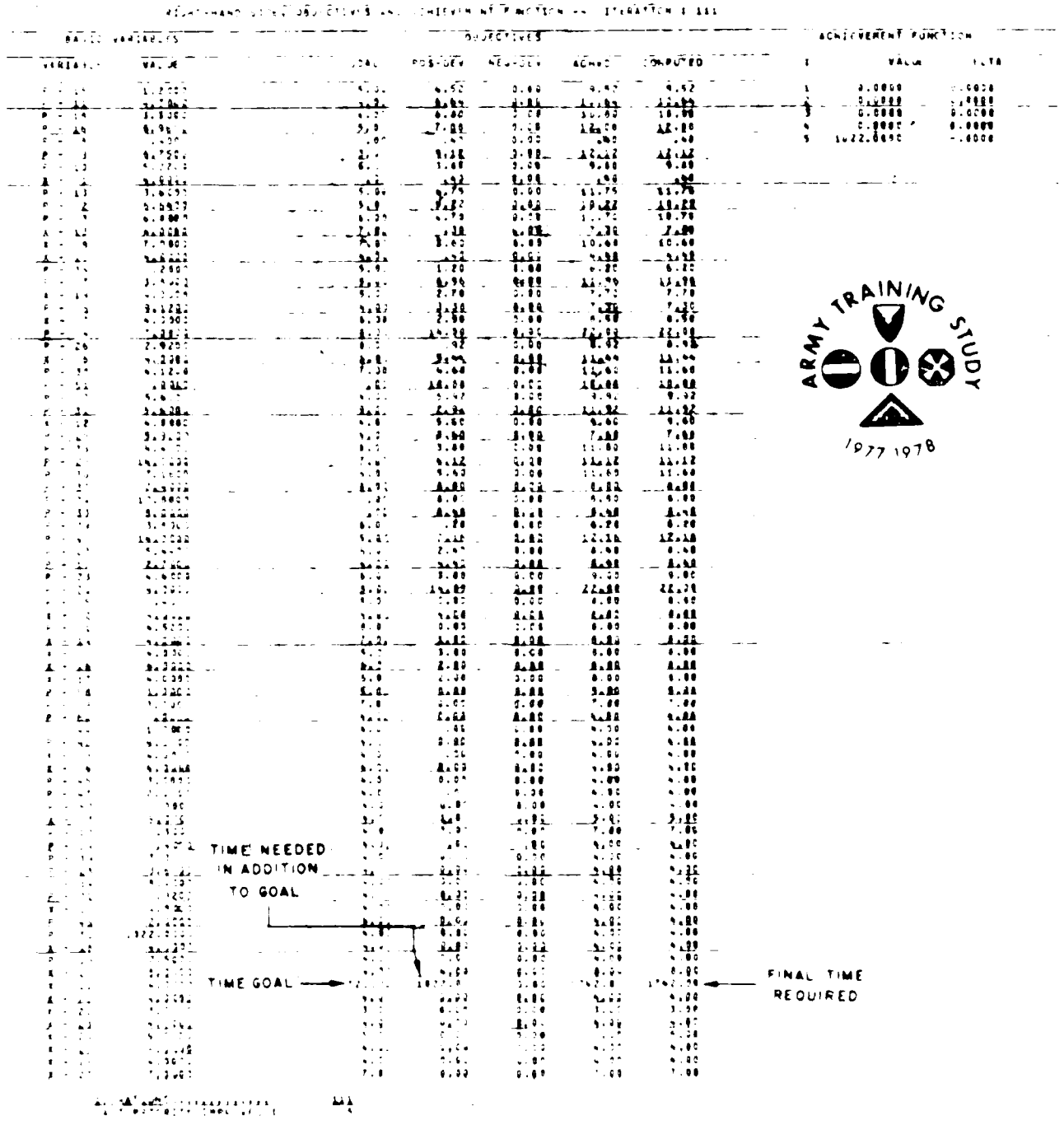
SAMPLE 2A

RIGHT-HAND SIDE, OBJECTIVES AND ACHIEVEMENT FUNCTION -- ITERATION 1 20

BASIC VARIABLES			OBJECTIVES					ACHIEVEMENT FUNCTION		
	VARIABLE	VALUE	GOAL	POS-DEV	NEG-DEV	ACHVD	COMPUTED	I	VALUE	DELTA
N - 1		1.0000	5.00	0.00	1.00	3.20	8.20	1	71.0509	-8.0291
P - 11		2.1881	3.00	3.28	0.00	5.28	5.28	2	72.0000	0.0000
P - 10		6.0000	6.00	6.00	0.00	0.00	0.00	3	52.0000	0.0000
P - 14		.2889	5.00	.28	0.00	5.28	5.28	4	31.0000	0.0000
N - 5		.0000	.00	0.00	.00	0.00	0.00	5	0.0000	0.0000
P - 9		11.0886	3.00	8.08	0.00	8.08	8.08			
P - 10		.0000	6.00	.40	0.00	6.40	6.40			
N - 8		.7727	.80	0.80	.00	0.80	0.80			
P - 53		12.0000	5.00	11.03	0.00	16.00	16.00			
P - 2		1.2888	5.00	.68	0.00	5.68	5.68			
P - 3		4.0000	8.00	0.00	0.00	0.00	0.00			
N - 12		1.0000	7.00	0.00	0.00	0.00	0.00			
N - 13		3.0000	7.00	0.00	3.00	3.20	3.20			
N - 14		2.0000	5.00	0.00	2.00	1.60	1.60			
N - 15		1.0000	5.00	0.00	1.00	3.20	3.20			
P - 7		.0000	5.00	.28	0.00	5.28	5.28			
N - 17		3.4000	5.00	0.00	3.40	1.60	1.60			
P - 6		5.0000	5.00	0.00	0.00	0.00	0.00			
N - 19		4.4000	6.00	0.00	4.40	1.60	1.60			
P - 4		.2888	5.00	0.00	0.00	0.00	0.00			
N - 21		6.2546	8.00	0.00	6.25	1.75	1.75			
N - 22		3.1200	5.00	0.00	3.12	2.08	2.08			
N - 23		2.6364	7.00	0.00	2.64	4.36	4.36			
P - 13		8.7273	.88	7.88	0.00	7.88	7.88			
N - 25		1.1200	4.00	0.00	1.12	2.88	2.88			
N - 26		4.6364	9.00	0.00	4.64	4.36	4.36			
N - 27		.5091	4.00	0.00	.51	3.49	3.49			
N - 28		.5091	4.00	0.00	.51	3.49	3.49			
P - 38		.3636	8.00	.73	0.00	8.73	8.73			
N - 30		1.9455	7.00	0.00	1.95	5.05	5.05			
N - 31		1.6364	6.00	0.00	1.64	4.36	4.36			
N - 32		5.5182	8.00	0.00	5.82	2.18	2.18			
P - 24		2.0000	.00	1.75	0.00	1.75	1.75			
P - 33		1.2454	.00	.87	0.00	.87	.87			
N - 35		4.2545	6.00	0.00	4.25	1.75	1.75			
N - 36		2.1201	5.00	0.00	2.12	2.88	2.88			
N - 37		5.1273	6.00	0.00	5.13	.87	.87			
P - 43		16.7273	8.00	.36	0.00	8.36	8.36			
N - 39		5.1273	6.00	0.00	5.13	.87	.87			
N - 40		5.6364	8.00	0.00	5.64	2.36	2.36			
N - 41		8.0000	8.00	0.00	0.00	0.00	0.00			
N - 42		4.2000	4.00	0.00	4.20	8.80	8.80			
P - 61		4.7273	8.00	16.73	0.00	24.73	24.73			
N - 44		7.8400	7.00	0.00	7.84	0.00	0.00			
N - 45		5.0000	5.00	0.00	5.00	0.00	0.00			
N - 46		6.0000	6.00	0.00	6.00	0.00	0.00			
N - 47		6.0000	6.00	0.00	6.00	0.00	0.00			
N - 48		5.0000	5.00	0.00	5.00	0.00	0.00			
N - 49		7.0000	7.00	0.00	7.00	0.00	0.00			
N - 50		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 51		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 52		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 1		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 54		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 55		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 56		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 57		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 58		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 59		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 60		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 2		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 64		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 65		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 66		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 67		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 68		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 69		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 70		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 3		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 74		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 75		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 76		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 77		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 78		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 79		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 80		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 4		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 84		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 85		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 86		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 87		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 88		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 89		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 90		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 5		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 94		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 95		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 96		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 97		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 98		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 99		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 100		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 6		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 104		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 105		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 106		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 107		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 108		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 109		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 110		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 7		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 114		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 115		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 116		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 117		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 118		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 119		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 120		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 8		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 124		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 125		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 126		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 127		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 128		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 129		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 130		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 9		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 134		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 135		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 136		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 137		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 138		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 139		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 140		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 10		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 144		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 145		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 146		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 147		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 148		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 149		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 150		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 11		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 154		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 155		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 156		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 157		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 158		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 159		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 160		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 12		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 164		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 165		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 166		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 167		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 168		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 169		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 170		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 13		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 174		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 175		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 176		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 177		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 178		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 179		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 180		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 14		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 184		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 185		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 186		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 187		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 188		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 189		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 190		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 15		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 194		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 195		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 196		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 197		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 198		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 199		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 200		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 16		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 204		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 205		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 206		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 207		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 208		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 209		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 210		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 17		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 214		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 215		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 216		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 217		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 218		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 219		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 220		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 18		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 224		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 225		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 226		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 227		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 228		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 229		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 230		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 19		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 234		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 235		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 236		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 237		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 238		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 239		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 240		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 20		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 244		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 245		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 246		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 247		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 248		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 249		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 250		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 21		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 254		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 255		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 256		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 257		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 258		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 259		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 260		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 22		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 264		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 265		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 266		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 267		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 268		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 269		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 270		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 23		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 274		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 275		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 276		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 277		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 278		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 279		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 280		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 24		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 284		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 285		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 286		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 287		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 288		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 289		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 290		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 25		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 294		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 295		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 296		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 297		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 298		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 299		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 300		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 26		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 304		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 305		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 306		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 307		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 308		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 309		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 310		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 27		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 314		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 315		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 316		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 317		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 318		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 319		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 320		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 28		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 324		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 325		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 326		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 327		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 328		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 329		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 330		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 29		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 334		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 335		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 336		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 337		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 338		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 339		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 340		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 30		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 344		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 345		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 346		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 347		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 348		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 349		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 350		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 31		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 354		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 355		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 356		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 357		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 358		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 359		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 360		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 32		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 364		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 365		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 366		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 367		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 368		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 369		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 370		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 33		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 374		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 375		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 376		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 377		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 378		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 379		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 380		4.2000	4.20	0.00	4.20	0.00	0.00			
I - 34		16.0000	4.00	12.00	0.00	16.00	16.00			
N - 384		4.2000	4.20	0.00	4.20	0.00	0.00			
N - 385		4.5000	4.50	0.00	4.50	0.00	0.00			
N - 386		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 387		4.0000	4.00	0.00	4.00	0.00	0.00			
N - 388		4.8000	4.80	0.00	4.80	0.00	0.00			
N - 389		4.0000


OVERTRAINING ATTENUATED
SHORT FALL RESOLVED
SHORT FALL RESOLVED
OVERTRAINING RESOLVED
OVERTRAINING RESOLVED
TIME GOAL
TIME USED
ACHIEVEMENT FUNCTION
ARMY TRAINING STUDY
1977-1978

SAMPLE 2C


TIME NEEDED
IN ADDITION
TO GOAL
TIME GOAL
FINAL TIME
REQUIRED

SAMPLE 20

GOAL PROGRAMMING

*** BATTALION TRAINING MODEL BATTLE DRILL INTEGRATION ***

INDIV MOS TASKS INTEGRATED INTO OPTIMAL BATTLE DRILLS TEST - 001

ANNUAL FREQUENCES
COLLECTIVE & INDIVIDUAL
TASKS

5 PRIORITIES | 27 DECISION VARIABLES | 79 OBJECTIVES

PRIORITY FINAL VALUES		ANNUAL BATTLE DRILL FREQUENCIES		POSITIVE DEVIATION	PRI WT	NEGATIVE DEVIATION	PRI WT	GOAL	COMPUTED
MAX [illegible] FREQ	0.00	MOVE CO	4.00	C FACT MOVE	4.62	0	0	0.00*	1	1	5.00	9.62
[illegible] FREQ	3,000	SUPPORT CO	9.00	C SEC & INTL	6.44	0	0	0.00*	1	1	4.00	10.44
MAX IND FREQ	0.00	FSB CO	4.00	C COV & CMCL	8.80	0	0	0.00*	1	1	4.00	12.80
MAX SGT FREQ	0.00	RTO CO	4.00	C AMBT SUPPT	7.00	0	0	0.00*	1	1	5.00	12.00
TIME OBJ	1,122.00	COMM CO	4.00	C SMALL ARMS	.40	5	0	0.00*	1	1	.00	.40
		RP/MAD CO	4.00	C FGHT VEH	9.12	0	0	0.00*	1	1	3.00	12.12
		SUSTAIN CO	4.00	C ANTI-TK MP	3.00	0	0	0.00*	1	1	9.00	9.00
		SUPPORT CO	8.00	C MORTARS	.48	0	0	0.00*	1	1	.00	.48
		NBC CO	7.00	C FIRE & MAN	6.75	0	0	0.00*	1	1	5.00	11.75
		RCBA CO	4.00	C RECON	5.22	0	0	0.00*	1	1	5.00	10.22
		MOVE P/S	4.00	C CONSOLIDATE	4.78	0	0	0.00*	1	1	6.00	10.78
		SUPPORT P/S	4.00	C NIGHT	.38	5	0	0.00*	1	1	7.00	7.38
		FSB P/S	4.00	C NBC OPNS	3.00	0	0	0.00*	1	1	7.00	10.00
		RTO P/S	4.00	C RCBA	.48	0	0	0.00*	1	1	4.00	4.48
		COMM P/S	4.00	C HOSTIL AIR	1.20	0	0	0.00*	1	1	5.00	6.20
SAMPLE 3		RP/MAD P/S	4.00	C [illegible] FM	6.76	0	0	0.00*	1	1	5.00	11.96
		SUSTAIN P/S	4.00	C BAT. PSN	7.78	0	0	0.00*	1	1	4.00	7.78
		SUPPORT P/A	4.00	C MINEFIELD	3.30	0	0	0.00*	1	1	4.00	7.30
		NBC P/S	4.00	C ESS	2.56	0	0	0.00*	1	1	5.00	4.56
		RCBA P/S	8.00	C [illegible] SPL	14.00	0	0	0.00*	1	1	7.00	22.00
		SEP IND NBC	4.00	P FACT MOVE	.92	0	0	0.00*	1	1	8.00	8.92
		SEP IND ENG	4.00	P SEC & INTL	5.44	0	0	0.00*	1	1	6.00	11.44
		SEP IND FIRE	4.00	P COV & CMCL	4.80	0	0	0.00*	1	1	7.00	11.80
		SEP IND RP/S	5.00	P AMBT SUPPT	11.88	0	0	0.00*	1	1	.00	11.88
		SEP IND MOVE	4.00	P SMALL ARMS	4.92	0	0	0.00*	1	1	4.00	8.92
		SEP IND COMM	4.00	P FGHT VEH	2.92	0	0	0.00*	1	1	9.00	11.92
		SEP IND RTO	7.00	P ANTI-TK MP	9.00	0	0	0.00*	1	1	4.00	9.00
				P MORTARS	7.60	0	0	0.00*	1	1	4.00	7.60
				P FIRE & MAN	3.00	0	0	0.00*	1	1	8.00	11.00
				P RECON	9.12	0	0	0.00*	1	1	7.00	11.12
				P CONSOLIDATE	5.00	0	0	0.00*	1	1	6.00	11.00
				P NIGHT	8.00	0	0	0.00*	1	1	8.00	8.00
				P NBC OPNS	8.00	0	0	0.00*	1	1	.00	8.00
				P RCBA	8.48	0	0	0.00*	1	1	.00	8.48
				P HOSTIL AIR	.20	0	0	0.00*	1	1	6.00	6.20
				P [illegible] FM	7.48	0	0	0.00*	1	1	5.00	12.48
				P BAT. PSN	7.48	0	0	0.00*	1	1	7.00	7.48
				P MINEFIELD	9.00	0	0	0.00*	1	1	9.00	9.00
				P ESS	3.06	0	0	0.00*	1	1	6.00	9.06
				P [illegible] SPL	14.00	0	0	0.00*	1	1	8.00	22.00
				[illegible]	3.00	0	0	0.00*	1	1	8.00	8.00

Chapter IV

PROGRAM ANALYSIS

General

The initial analytical efforts using the Battalion Training Model fell into three broad areas: selection of a first generation training program which represented a realistically achievable program for the 95% battlefield; determining the sensitivity of the model to varying personnel conditions; and development of training programs associated with varying levels of readiness.

The analytical baseline was developed by combining the 95% battlefield training program with results of the Battalion Training Survey and the Best Battalion Costing Program. The baseline conditions were taken from the Battalion Training Survey, specifically 25% not present for training, 35% turbulence per quarter, and 15% trainer grade substitution.

For each analysis, BTM inputs were adjusted to model the effects under consideration, and key outputs were examined. Outputs selected for examination were the training time distribution and dollar cost. Training time was broken into the categories of training program time, maintenance time, and nontraining time. To be realistic, time distribution was based on 253 usable training days. This figure was arrived at by subtracting from 365 days an allowance for weekends and holidays. The goal program was prioritized to ensure that training and maintenance were given first priority, consuming nontraining time and exceeding 253 days if necessary. Only the 365 calendar day limit was firm; time was distributed within that limit.

The computer program groups training time into X, Y, and Z days, with goals of 85, 85, and 83 days respectively. Contained in the 253-day totals are following types of activities: time in days required for ARTEP, FTX, battle drills, soldier's manual training, nonsoldier's manual individual training, SQT preparation, mission training, maintenance, and athletics and recreation. Some types of training, such as leader training (CPX), and NCO training time, do not require calendar days from the 253 day total in that they could be conducted during off-duty time or concurrent with other training activities. The same is true of combat support company activities such as TOW, mortar, GSR, and scout training--these unique elements consume equipment days and dollars, but the time to conduct them would be concurrent with other training activities. The support battle drill falls into this category also, in that it requires leader time but not troop time and, therefore, does not count against the day total.

To categorize the year into the days devoted specifically to training activities, maintenance days, and days for nontraining activities (such as parades, ceremonies, organization days, etc.), maintenance days have to be subtracted from the total X, Y, and Z days. Maintenance days appear as "MAINT Y DAYS" and "MAINT Z DAYS" on the computer printout. In addition, the sustain battle drill contains 30 days of maintenance. Thus, to distinguish maintenance days from training days requires the following computations:

Maintenance days = MAINT Y DAYS + MAINT Z DAYS + 30 DAYS

Days for training activities then become:

Training program days = X DAYS + Y DAYS + Z DAYS - Maintenance days.

Days available for nontraining activities are determined by adjusting the nontraining days total shown on the computer printout for the 112 normal days off and any negative deviation from a 365-day year. The significance of a negative deviation from 365 days is that where it appears, the goal programming algorithm was able to accommodate all time-consuming activities within less than a full calendar year and thus the negative deviation has to be added back in to account for the whole year. Note that when the NON TNG DAYS total shown on the results printout is less than 112, the implication is that the shortfall will be made up on weekends and holidays. Thus,

Days available for nontraining activities = NON TNG DAYS + negative deviations from 365 days - 112 days (weekends and holidays)

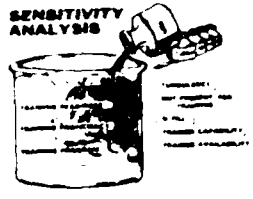
Dollar costs are expressed as ammunition, gasoline, diesel, spare parts, and total P2 dollars. In the BTM, ammunition costs are associated with battle drills, and the other dollars are determined by the number of days required for training.

The 95% Baseline Training Program

The analytical baseline, while technically representing an executable program, does not represent a realistic training program for a battalion. The baseline allowed only 93.6 days for all nontraining activities, to include weekends, ceremonies, etc. To bring the fully integrated program into a reasonable context, personnel factors were varied within realizable limits to develop alternative training programs, which could realistically be accomplished by a battalion. The results are displayed at Table IV-1.



BATTALION TRAINING MODEL

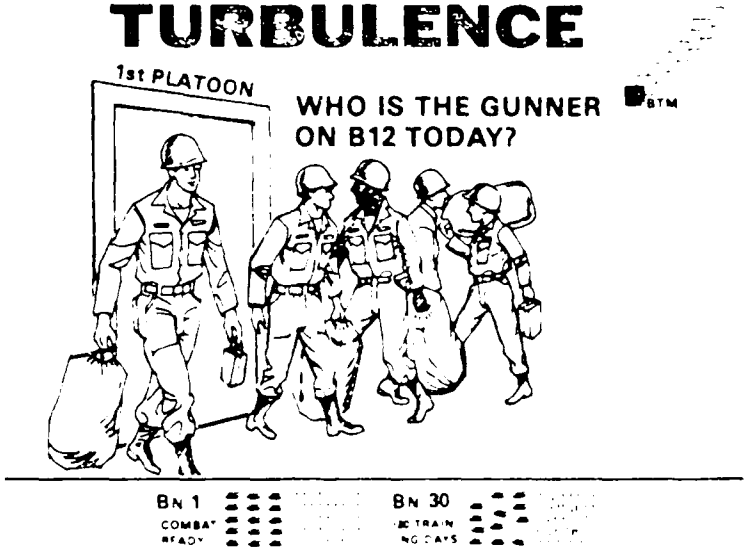


	Analytical Baseline			95% Baseline	
Turbulence	35%	20%	20%	20%	20%
Not Present Tng	25%	25%	15%	20%	20%
Tnr Grade Sub	15%	15%	15%	15%	10%
Days					
Training Program	213.4	161.6	122.7	141.2	124.4
Maintenance	58.0	58.0	58.0	58.0	58.0
Non Training	0	33.4	72.3	53.8	70.7
Wknd/Hol	93.6	112.0	112.0	112.0	112.0
%/253 Days					
Training Program	84.3*	63.9	48.5	55.8	49.2
Maintenance	22.9*	22.9	22.9	22.9	22.9
Non Training	0	13.2	28.6	21.3	27.9
Total P2 $	$515,965	$430,284	$366,024	$396,624	$370,491
Total CL V $ (QL4)	$2,427,854	$1,887,133	$1,481,593	$1,674,707	$1,674,707

*Percentages do not add to 100% in that program is not executable within 253 days.

Table IV-1. The 95% Baseline Training Program
(Requirements given varying personnel conditions) (QL3)

The first alternative considered was reduction of turbulence. Turbulence as used in this context represents changes in job position; that is, the results of moving troops to new duties both as a result of transfers in and out of the battlion and of reassigning troops to other duties within the unit.

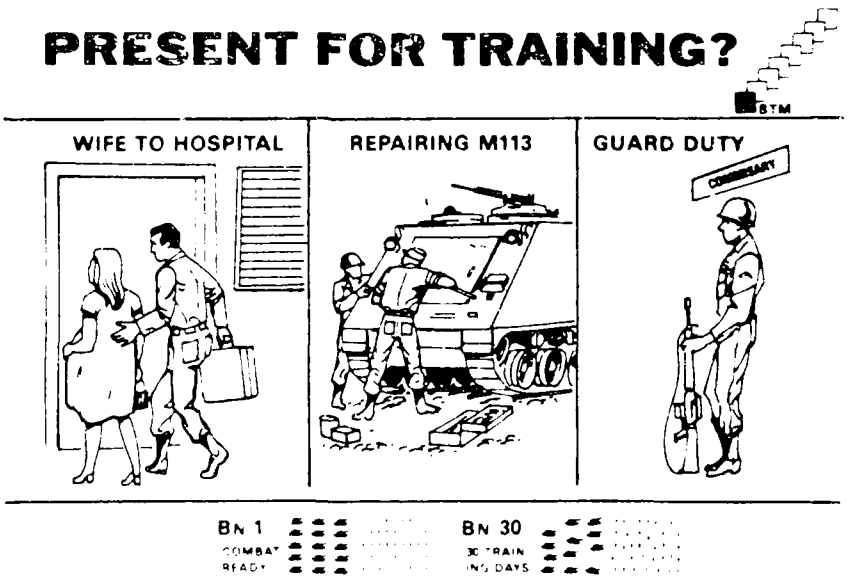


As a rule of thumb, developed from limited data, it appears that turbulence is approximately twice the quartely turnover rate reflected in the 2715 report. Lowering the turbulence rate to 20% made a substantial increase in the availability of nontraining time, as is reflected in the 20% turbulence, 25% not present for training, and 15% trainer grade substitution column of Table IV-1. The total time available for nontraining activities of 145.4 days, while representing a considerable improvement, still allowed only approximately 3 days per month for all other activities, if weekends and holidays were observed. A level of 20% turbulence was accepted, but further improvements were sought which would result in a more desirable distribution of time.

At this point, it is appropriate to discuss the rationale involved in combining variations of two or more personnel factors. The battalion Training Survey provided factors based on variations of a single variable at a time. Since the survey contained no compounded questions varying more than one factor at a time, it is not clear, from a survey point of view, how to apply the factors in combination. However, a combinatorial

technique can be derived by examining the underlying phenomena. Trainer grade substitution presumes that a more experienced trainer can conduct the required training in less time; this is independent of the frequency with which he teaches it, so this variable can be superimposed over frequency changes caused by turbulence or not present for training. Turbulence causes the frequency of training to increase for basically two reasons: the soldier may have to pick up some new individual skills peculiar to this new job, and collective training will have to be conducted more often to develop team work as crews and squads are shuffled. Thus, the total amount of training he must receive increases. On the other hand, "not present for training" causes training to be conducted more often because the soldier is more likely to be absent and miss a particular training session. This is independent of the total amount of training he requires. Since the effect of the two personnel conditions are not interactive, the adjustment factors for turbulence and "not present for training" can be applied in combination.

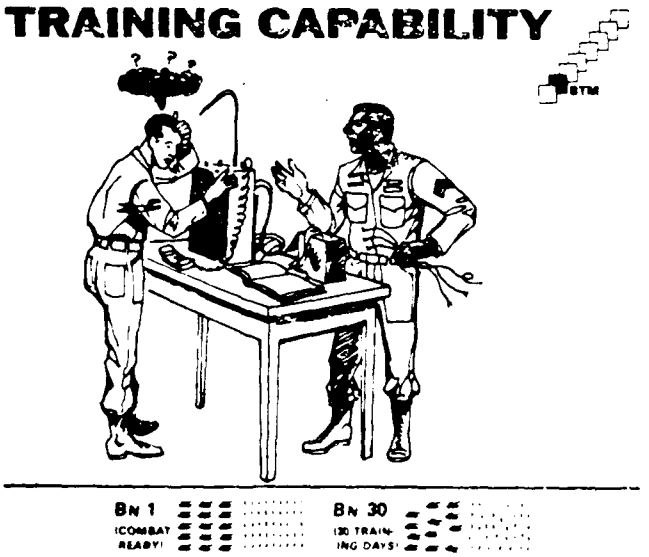
Holding the turbulence level at 20%, alternatives were considered which varied the "not present for training" level from 25% to 15% and 20%. The 15% level resulted in increase from approximately 3 days per month to 6 days per month available for nontraining activities; however, it is questionable whether a unit could sustain this level of participation



throughout the training year. The "not present for training" figure includes personnel on leave, sick call, and away at school, all of which

are legitimate requirements but which take troops away from training. The 20% "not present for training" rate seemed more reasonable. In comparison with the 25% "not present for training" rate of the analytical baseline, the 20% "not present for training" rate permitted completion of the training requirement in 20 fewer days per year.

Proceeding from the 20% turbulence, 20% "not present for training," 15% trainer grade substitution case, a variation of 10% trainer grade substitution was run, yielding the results shown in the last column of Table 1. Note that a 5% improvement in trainer grade substitution does not improve either time or the cost of training as much as a 5% improvement in "not present for training." Again, it is questionable that a trainer grade substitution level of 10% is realistically maintainable in the Army's peacetime environment. First, availability of trainers of the appropriate grade can be no better than the percentage fill of officers and NCOs, and many units are experiencing fill rates considerably below 90%, particularly for key NCOs. Secondly, nontraining requirements for MAIT teams, division schools, and the like continue to take NCOs away from units. So while improved trainer grade substitution is desirable, it did not seem practical to include in a program intended to be achievable.

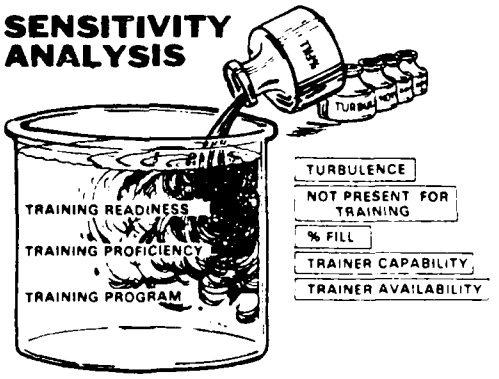


The 95% Baseline Training Program is dependent on holding turbulence and "not present for training" to 20%, and trainer grade substitution to 15%. If the percentages reflected in the analytical baseline and the Battalion Traning Survey are typical of the Army at present, attaining

the personnel conditions hypothesized in the 95% baseline appear to be achievable, but doing so will require management attention at DA, MACOM, and unit level. Quarterly turnover rates of 10%, in conjunction with intensified action at unit level to minimize shifting of personnel within the unit, should address the turbulence condition. Within the unit, internal and external training distractors must be reduced and training must be given sufficient priority to insure that an 80% present for training level is maintained. To maintain a 15% trainer grade subsitution rate requires that all available NCOs be assigned in their proper jobs and presumes that they in fact be competent to conduct required training.

Sensitivity Analyses

Starting from the analytical baseline, high and low variations of the three primary personnel considerations were assessed to determine the effect on the required training for the 95% battlefield standard. Results are shown in Table IV-3 and discussed below.



Turbulence

Turbulence is described as changes in duty positions, i.e., the personnel movements within the unit. Data for this computation were taken from the Battalion Training Survey. Survey results are shown below:

Turbulence	20%	30%	35%	40%	50%	60%
Frequency Factor	.72	.89	1.00	1.14	1.51	2.04

Table IV-2. Effects on Frequency of Sustainment Training (at 95% Proficiency Level) Caused by Changes in Turbulence (% per Quarter) (QL3)

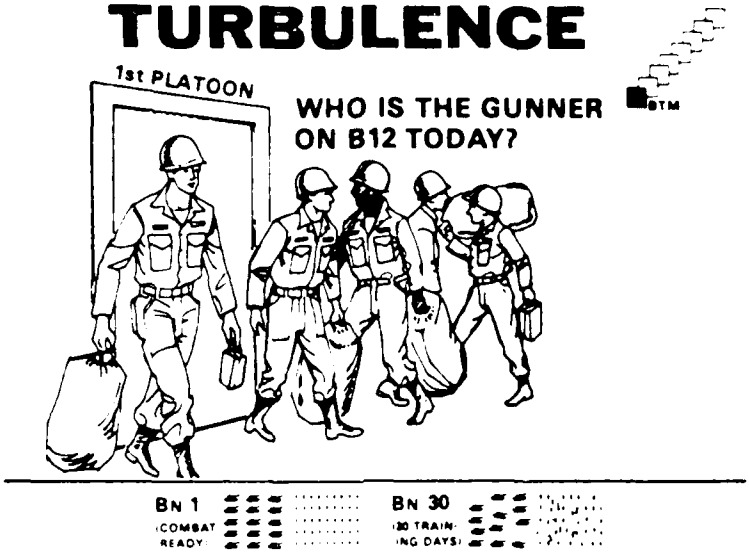
Conditions	Training Time		Non-Tng Time		Maintenance		Tng Program		P2 $	C1 V $ (QL4)
	Days	%	Days	%	Days	%	% Battle Drill Compl	% Other Tng Compl	$ M	$ M
Turbulence										
20%	162	64	33	13	58	23	100	100	.43	1.89
35%	213	84	-18	-	58	23	100	100	.52	2.43
50%	307	121	-112	-	58	23	100	99.5	.67	3.41
Not Pres Tng										
15%	160	63	35	14	58	23	100	100	.43	1.87
25%	213	84	-18	-	58	23	100	100	.52	2.43
40%	307	121	-112	-	58	23	100	96	.68	3.47
Trainer Subs										
10%	190	75	5	2	58	23	100	100	.47	2.43
15%	213	84	-18	-	58	23	100	100	.52	2.43
40%	307	121	-112	-	58	23	83	89	.61	2.32
Less Qual Trainee										
(QL 4)	307	121	-112	-	58	23	92	88	.76	3.38

Table IV-3. Sensitivity Run Results (QL3)

1) Expressed as percent of 253 usable training/working days.

2) Does not include 112 days or weekends and holidays. Negative number implies work weekends/holidays.

Factors shown in the table above can be used as multipliers to the battle drill frequencies to define a new training program based on the specified level of turbulence. For analysis purposes, turbulence levels of 20% and 50% were selected. In the BTM, the training goals in number of battle drills were multiplied by .72 (reflecting 20% change in duty position per quarter) and 1.51 (reflecting 50% change in duty position per quarter).



Varying turbulence to 20% and 50% from a baseline 35% yields the results shown on Table IV-3. Summarizing the turbulence results:

	20%	35%	50%
Training Days	162	213	307
Nontraining Days	33	-18*	-112*
Maintenance Days	58	58	58
P2 Costs ($M)	.43	.52	.67
Ammunition Costs ($M) (QL4)	1.89	2.43	3.41

* Negative days imply work on weekends/holidays.

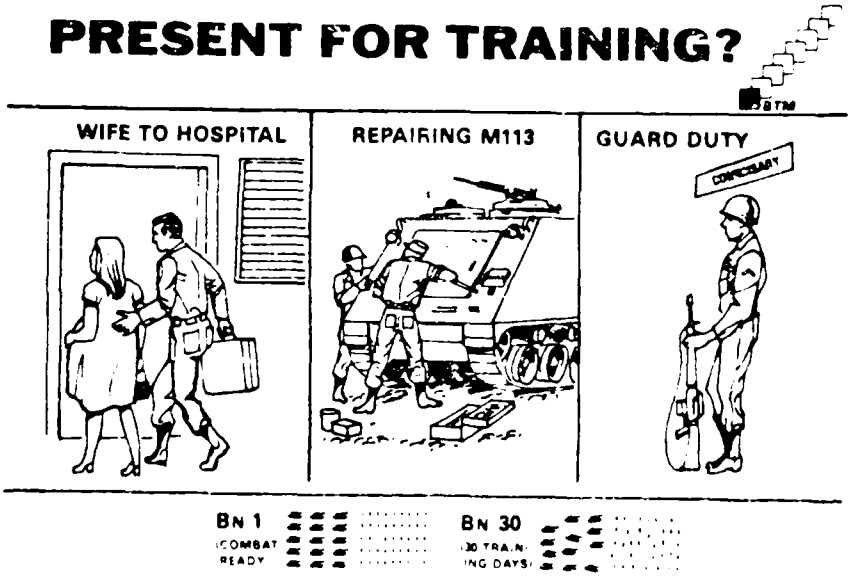
Table IV-4. Effects of High and Low Turbulence (% per Quarter) on the Analytical Baseline (QL3)

the variations of conditions, high and low, are equal (that is ± 15% from the baseline), but the results are distinctly unequal. At the high turbulence level, which some units may be experiencing now, an additional 94 training days are required, a 44% increase above a program that is already practically unexecutable. Stated another way, the high turbulence case would require that 94 days be taken from what would normally be weekends and holidays in order to conduct minimum training and maintenance, not including any time required for nontraining activities. On the other hand, lowering turbulence an equal amount frees 51 days from training (due to decreased repetitions) so that 33 nontraining days are available. Likewise, the costs vary asymmetrically, decreasing 17% for P2 and 22% for ammunition in the improved case, and increasing 29% (P2) and 40% (ammo) for the worsened turbulence.

Turbulence is regarded by many as the Army's primary detractor from training. If the personnel conditions shown in the base case are realistic conditions for today's Army, then even if a unit is accomplishing fully integrated training it is still falling short of the standards required for the 95% battlefield. If the personnel conditions are worse, the training situation becomes impossible if the objective is 95% proficiency, that is, combat ready tomorrow. On the positive side, however, a relatively modest improvement in turbulence results in a substantial improvement in training days.

Not Present for Training

The "not present for training" category describes the daily turmoil within a unit in terms of soldiers who are not available for training due to details, administrative requirements, medical appointments, or other



reasons. This percent can be expected to vary during the year depending on whether a unit is on prime time training (X-time), post support (Z-time), or back-up post support (Y-time). The figures shown here represent an average or Y-time percent. Data for this computation was taken from the Battalion Training Survey. Survey results are shown below:

Not Present for Tng	15%	20%	25%	30%	40%	50%	60%
Frequency Factor	.71	.85	1.00	1.16	1.54	2.00	2.57

Table IV-5. Effects on Frequency of Sustainment Training (at 95% Proficiency Level) Caused by Changes In "Not Present for Training" (Average Daily %) (QL3)

Factors shown in the table above serve as multipliers to the battle drill frequencies to define a training program for the specified level of "not present for training." The levels 15% and 40% were selected as low and high alternatives for analysis purposes. The training goals in the STM, expressed as a number of battle drills, were multiplied by .71 and 1.54, respectively.

In addition, the coefficient matrix describing personnel conditions was also changed to represent the appropriate level of personnel not present for training.

	15%	25%	40%
Training Days	160	213	307
Nontraining Days	35	-18*	-112*
Maintenance Days	58	58	58
P2 Cost ($M)	.43	.52	.68
Ammunition Cost ($M) (QL4)	1.87	2.43	3.47

* Negative days implies work on weekends/holidays.

Table IV-6. Effects of High and Low "Not Present for Training" (Average Daily %) on the Analytical Baseline (QL3)

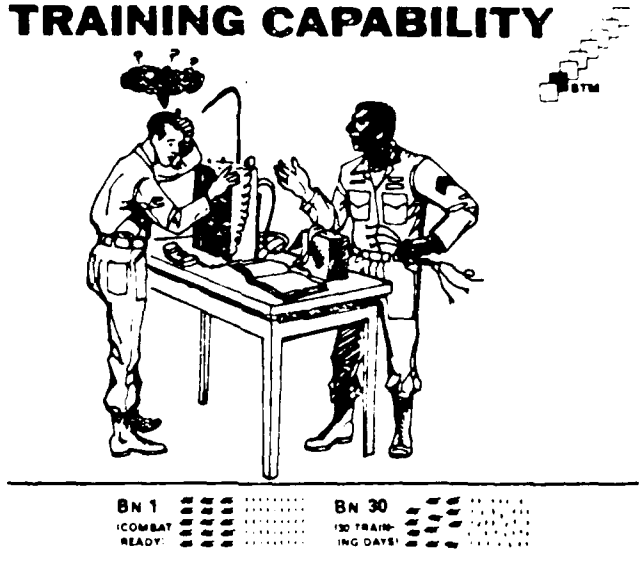
In this case, the high and low variations from the baseline are not equal (10% below, 15% above), but the results represent an even larger percent variation. By increasing the percentage of troops attending training by 10%, the number of required training days decreases 25%, and the cost of training decreases by an annual total of $650,000, considering both P2 and ammunition.

The causes of troops being unavailable for training for other duties are many and varied. They may be assigned to special duty which takes

them away, days or months at a time. They may simply be taken on the spur of the moment for detail, or they may be attending to personal requirements. In any event, the basic cause is that other requirements are deemed more important than training. As the figures above indicate, a high level of "not present for training" results in a high price; in dollars, in time, and in failure to meet the standards of the 95% battlefield.

Trainer Grade Substitution

"Trainer grade substitution" refers to the effect on training of substitution of trainer of a lower grade than prescribed by the Table of Organization and Equipment. The basic premise is that the less experienced trainer would require more time per training period to train his men



to the same level of competence. The factors used to modify the length of time to train were taken from the Battalion Training Survey. Factors from the survey are shown below:

Trainer Grade Sub	10%	15%	20%	25%	30%	40%
Training Time Factor	.86	1.00	1.18	1.39	1.64	2.31

Table IV-7. Effect on Length of Training Period (for 95% Proficiency) Caused By Trainer Grade Substitution %. (QL3)

Factors for 10% and 40% grade substitution were used to modify the length of training time in the BTM. The lengths of the time to train coefficients were modified by 0.86 and 2.31 respectively.

Shown below are the summarizing results of varying the level of trainer grade substitution from Table IV-3:

	10%	15%	40%
Training Days	190	213	307
Nontraining Days	5	-18*	-112*
Maintenance Days	58	50	58
P2 Cost ($M)	.47	.52	.61
Ammunition Cost ($M (QL4)	2.43	2.43	2.32
Program Completion	100%	100%	83%

*Negative days imply work on weekends/holidays.

Table IV-8. Effects of High and Low Trainer Grade Substitution on the Analytical Baseline (QL3)

Improvements in trainer grade substitution (reduction to 10%) seem to give less dramatic results than variations in either turbulence or present for training. Due to the nature of trainer grade substitution, the training program is the same as the analytical baseline in terms of number of repetitions of battle drills and is executed completely. The program is executed in 23 fewer days.

The worsened substitution, 40% grade substitution, results in a program that reaches only 83% completion, despite an increase in training days of 94 days. The 40% case is, however, a more drastic change from the base (more than double) that was the case for either turbulence or not present for training. Note that in this case the dollar cost dropped off somewhat from the base case, simply because the training program could not be executed. The limiting constraint on program execution is trainer mandays.

The disturbing fact about trainer grade substitution is that the higher figure of 40% may represent what many units are presently experiencing, as NCOs are diverted from TOE units to other jobs. To the extent that the factors developed from the BTS are accurate, a situation exists which makes the 95% battlefield standard unobtainable. These results add emphasis to the necessity to utilize NCOs in their proper duty positions.

Less Qualified Trainee (Mental Category IV)

For this sensitivity run, an attempt was made to determine the effect on the unit training program of less qualified trainees. The Battalion

Training Survey provided the data that, in the opinion of those surveyed, the frequency of training would have to be increased by a factor of 1.5, and the training time by 1.4 for a unit with a majority of Cat IV's. These factors were applied to the battle drill repetitions and the length of training parameters in the BTM. Personnel conditions (turbulence, not present for training, trainer grade substitutions) remained the same as the analytical baseline.

It should be noted that the factors obtained by the survey are subject to question since many of the respondents had little experience with lower mental category soldiers.

	Baseline	Cat IV
Training Days	213	307
Nontraining Days	-18*	-112
Maintenance Days	58	58
P2 Cost ($M)	.52	.76
Ammunition Costs ($M)	2.43	3.38
Program Completion	100%	90%

* Negative days implies working weekends/holidays.

Table IV-9. Effects of Mental Category IV Trainees on the Analytical Baseline (QL4)

As the results displayed in Table IV-3 show, the effect of the lesser qualified trainee is disturbing, costing a total of $1.2M more than the analytical baseline and falling approximately 10% short of completion of the 95% battle field training program. This is a particularly alarming result if more mental category IV soldiers enter the force in the future. The implication for trainers is that effort must be expended to develop classification systems and training packages that will serve to reduce the time and frequency multiplier effects found by the training survey.

Readiness Keyed Programs

The next category of computer runs by the BTM dealt with this basic question: suppose that rather than gearing the training program to the standards of the 95% battlefield on a continuing basis, a unit trains to a lesser standard during peacetime and trains up after being alerted and before commitment to combat. What would it cost to execute this post-alert training and what effect would this approach have on any sustaining training program? Using terminology found elsewhere in this volume, a battalion with 5 training days prior to commitment is referred to as Bn-5, 10 training days Bn-10, etc. Thus, the task was to design training programs for Bn-5, Bn-10, Bn-20, and Bn-30 battalions, each program consisting of a sustaining and post-alert package.

TRAINING READINESS BTM

RESERVE COMPONENT (CONUS)



BN-30=30 DAYS OF TRAINING PRIOR TO COMBAT

ACTIVE (CONUS)



BN-15=15 DAYS OF TRAINING PRIOR TO COMBAT

ACTIVE FORWARD DEPLOYED



BN-1=1 DAY TO COMBAT

Once again the Battalion Training Survey served as the source of data. The survey respondents felt that when the length of time between repetitions is doubled, the length of training time required to make up for the increased decay is one-third larger than the normal training period. In other words, reducing the frequency of training by half caused the time length of each training period to be increased by one-third across all task. Applying this finding to the problem at hand, the frequency of those battle drills planned for training as part of post-alert can be cut in half during sustainment training, so long as the length of training is increased by one-third.

The starting point for the analysis is the 95% Baseline Training Program. As a first approximation, the BTM goal program was utilized to select the post-alert training packages (alternative packages were also developed). The 95% Baseline program was modified to incorporate conditions that would seem realistic for a post-alert situation. The length of the training day was extended from 8 to 10 hours in garrison and from 10 to 12 hours in the field (bear in mind this is training time, not time for meals, movement, etc.). The present for training percentage was increased to 90% for the Bn-5 and Bn-10 post-alert programs, and 85% for the Bn-20 and Bn-30. The assumption is that even under post-alert conditions, there would be some troops absent from training for administrative requirements. The goal program was prioritized so as to select as

many battle drills as possible, within the constraint of the 5, 10, 20, or 30 training days allotted. The Bn-20 and Bn-30 programs also include an ARTEP evaluation. The post-alert training programs selected by the computer are shown at Table IV-10. For comparison purposes, programs tailored by ARTS are shown at Table IV-11.

Based on the results of the post-alert runs, matching sustainment training programs were developed. The technique was to take those battle drills selected for conduct post-alert, then increase their time to train by one-third and cut the frequency in half. The results are at Table 12. As is reflected in the results, significant dollar savings are possible.

Package	Bn-5	Bn-10	Bn-20	Bn-30
Training Activity (Repetitions)				
ARTEP	0	0	1	1
Move Co	1	1	1	1
Move(Plt/Sqd)	1	1	1	1
Shoot Co	1	1	1	1
Shoot(Plt/Sqd)	0	0	0	1
F&M Co	0	0	1	1
R&S Co	0	1	1	1
Comm Co	1	1	1	1
BP/H Co	0	1	1	1
BP/H(Plt/Sqd)	0	0	1	1
Sustain Co	1	1	1	1
Sustain(Plt/Sqd)	0	0	0	1
Support Co	1	1	1	1
NBC	0	0	1	1
MOUT	0	1	1	1
(Days)				
Ldr Tng	0	0	5	5
NCO Tng	5	5	5	5
Scout Tng	0	5	5	5
Redeye Tng	5	5	5	5
GSR Tng	5	5	5	5
P2 $	12,543	27,303	59,277	69,661
CL V $ (QL4)	90,250	111,480	230,865	550,130

Table IV-10. Post-Alert Training Packages* (QL3)

*The goal programming algorithm attempts to conduct as many battle drills as possible within the time constraint, thus it will select the shorter drills first. The drills vary in length, hence the number of drills cannot be directly related to the number of days.

Package	Bn-5	Bn-10
Training Activity (Days)		
Move Co	.25	.5
Shoot(Plt/Sqd)	1	2
F&M Co	1	2
R&S Co	1	2
Comm Co	.25	.5
BP/H Co	1	2
NBC	.25	.5
MOUT	.25	.5
NCO Tng	5	5
Scout Tng	5	5
Redeye Tng	5	5
GSR Tng	5	5
P2 $	14,588	26,028
CL V $ (QL4)	356,526	356,526

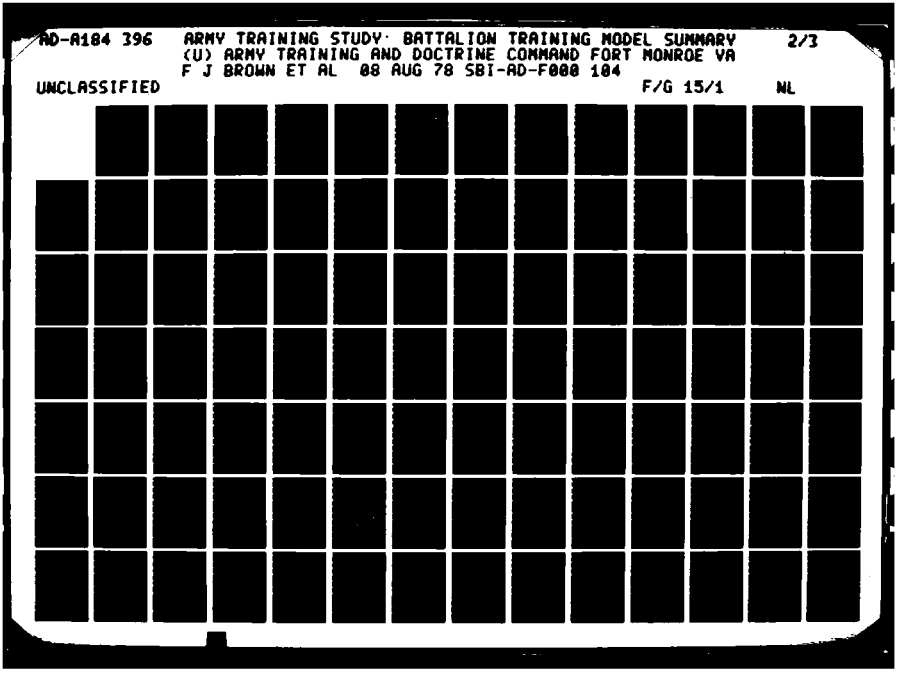
Table IV-11. Tailored Post-Alert Training Packages* (QL3)

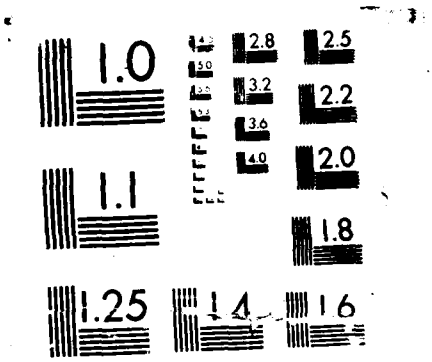
*For the tailored program, battle drills were expressed as a specific portion of a day. Note that the drills selected were more expensive than those selected by the goal program, primarily due to inclusion of the Shoot (Plat/Squad) battle drill, which is a large consumer of Class V.

More important than specific results, however, is the approach represented in this analysis. By deferring certain training until after alert there is a potential dollar savings that occurs every peacetime year. Secondly, approved Bn-1, Bn-5, Bn-10, Bn-20, Bn-30 training program represent benchmarks against which units can be provided resources and these benchmarks can be related to missions and deployment times.

Two cautions are in order. First, the above discussion is based on the premise that if a unit is given adequate resources it will train to the appropriate level. Only an independent evaluation system can confirm this vital assumption. Secondly, the post-alert training programs assume that the dollars, or more accurately, the goods they represent, are immediately available upon mobilization. There may be other real world considerations, such as range or equipment availability, which would make the deferred training approach impractical. This would be the case should a division, for instance, have only a brigade's worth of equipment. A possible solution might be a mix of BN levels within a division. This

requirement for multiple simultaneous training resources post-alert may preclude application of this approach to units deploying in less than 20 or 30 days. On the other hand, investment in the necessary additional facilities and reserve stocks might pay for itself overtime. Further analysis is required.

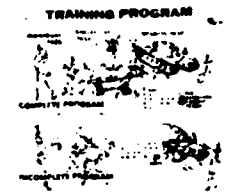

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ARMY TRAINING STUDY· BATTALION TRAINING MODEL SUMMARY
(U) ARMY TRAINING AND DOCTRINE COMMAND FORT MONROE VA
F J BROWN ET AL 08 AUG 78 SBI-AD-F000 104
2/3
UNCLASSIFIED
F/G 15/1
NL



MICROCOPY RESOLUTION TEST CHART



BATTALION TRAINING MODEL



	95% Baseline Training Program Bn-1 Sustaining	BN-5 Sustaining Program	BN-10 Sustaining Program	BN-20 Sustaining Program	BN-30 Sustaining Program
Days					
Tng Program	141	137	133	125	115
Maintenance	58	58	58	58	58
Non Training	54	58	62	70	80
Wknd/Hol	112	112	112	112	112
%/253 Days					
Tng Program	56	54	53	49	45
Maintenance	23	23	23	23	23
Non Training	21	23	24	28	32
Total P2 $	396,625	384,020	376,232	362,385	352,419
Total C1 V $ (QL4)	1,674,708	1,569,070	1,545,283	1,500,265	1,118,662

Table IV-12. Sustainment Training Programs

(Based on 20% Quarterly Turbulence, 20% Not Present for Training, 15% Trainer Grade Sustitution) (QL3)

Chapter V

CONCLUSIONS AND RECOMMENDATIONS

Tentative results and conclusions for the descriptive training programs described in Chapter IV are presented followed by results and conclusions pertaining to a prescriptive training resource model and costing methodology to support those programs. The chapter is concluded by substantive and administrative recommendations.

Descriptive Training Programs

a. Tentative Results - First generation training programs based on a ground force capable of fighting to Bn-1 (95%) readiness standards with no warning time (Bn-1) or 5, 10, 20, and 30 days warning have been developed (see chapter IV). As indicated earlier, the programs were formulated based on data from the Battalion Training Survey as appended and expanded upon (QL3) by TEA '78 and "Best Battalion" Costing Program data. Integration factors were applied and the results were factored into a program whose linchpins are represented by the following assumptions:

- ORGANIZATION OF WEEK
  - X TIME - 10 HR/DAY - 6 DAYS WEEK
  - Y TIME - 3 DAYS FIELD, 2 DAYS MAINTENANCE - 2 DAYS WEEKEND PER WEEK
  - Z TIME - 1 DAY TRAINING, 9 DAYS SUPPORT, 4 DAYS WEEKEND PER 2-WEEK PERIOD
- TRAINING PRIORITY PERIODS
  - X, Y, & Z = 2-WEEK BLOCKS
  - MTX = 3-WEEK BLOCK - THREE PER YEAR
- TRAINING DRILLS - Y & Z TIME - GARRISON & CLOSE IN RANGES
- BATTLE DRILLS - X TIME - LTA & MTA*
- ARTEP MISSIONS - X TIME - MTA

*FOR FORSCOM LTA = NONPRIORITY USE OF MANEUVER AREAS: MTA = PRIORITY USE OF MANEUVER AREAS

. TRAINING FOCUS
  - CREWS/SQD - TRAINING DRILLS - GARRISON, LTA & RANGES
  - PLATOONS - BATTLE DRILLS - LTAs
  - CO/TM - BATTLE DRILLS & COMBINED ARMS EXERCISES, ARTEP MISSIONS (PRIORITY) - MTAs
  - BN/TF - COMBINED ARMS ARTEP MISSIONS (MTA), TAC_R, GDP MISSION TRAINING (NONPRIORITY PERIODS)

. TRAINING FOCUS
  - NCOs - SM, TRAINING DRILLS & MAINTENANCE
  - OFFICERS - BATTLE DRILLS, ARTEP & GDP

. DECREMENTING PRIORITY: REDUCED FREQUENCY OF BATTLE DRILLS (I.E., FEWER TACTICAL CONDITIONS)

. GUNNERY - INTEGRAL PART SHOOT BATTLE DRILL
  - IND ARMS - QUALIFY 1 PER YEAR
  - IND ARMS - VERIFY PROFICIENCY 3 PER YEAR
  - CREW SERVED - 1 PER QUARTER
  - CO LEVEL CALFEX - 1 PER YEAR PLUS 1 SUBCALIBER PER YEAR
  - BN LEVEL CALFEX - 1 PER YEAR

. MAINTENANCE
  - 1 HOUR PER DAY
  - 2 DAYS PER MONTH - Y & 2 } 27% } 35% (INCLUDES CONCURRENT TRAINING)
  - 1 DAY PER WEEK
  - 1 DAY PER QUARTER
  - TRAINING MAINTENANCE - CONCURRENT

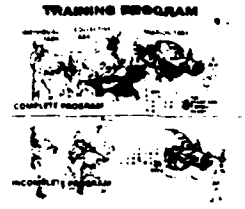
. MISSION TASKS - 3 DAYS PER QUARTER

. MANDATORY TRAINING & SQT PREP - 9 DAYS PER YEAR

. NONTRAINING TIME - 17 WEEKS/PER YEAR - FORSCOM
  14 WEEKS/PER YEAR - USAREUR

The resultant program for personnel conditions approximating the mean between FORSCOM and USAREUR is outlined as Set I below (the analytical baseline). The Set II program (95% baseline) was developed after applying *Battalion Training Survey* correction factors for the more favorable personnel conditions indicated. (QL3)





PERSONNEL CONDITION	SET I	SET II
Turbulence %/Qtr	35%	20%
Not Present for Tng %/Day	25%	20%
Fill-Officer/NCO	85%	85%

ARTEP/BATTLE DRILLS	Time (Hr)	Frequency	Time(Hr)	Frequency
ARTEP Diagnostic	72	1/QTR	72	1/Qtr
Move (Company)	7	1/Yr	7	1/Yr
Move (Plat & Sqd)	22	4/Yr	22	4/Yr
Shoot (Company)	5	4/Yr	5	3/Yr
Shoot (Plat & Sqd)	41	4/Yr	41	3/Yr
Fire/Maneuver (Co)	21	4/Yr	21	3/Yr
Fire/Maneuver (Plat & Sqd)	49	6/Yr	49	4/Yr
Recon/Security (Co)	16	5/Yr	16	3/Yr
Recon/Security (Plat & Sqd)	59	3/Yr	59	2/Yr
Commo (Company)	6	4/Yr	6	3/Yr
Commo (Plat & Sqd)	15	3/Yr	15	2/Yr
Battle Position (Co)	14	4/Yr	14	3/Yr
Battle Position (Plat & Sqd)	37	4/Yr	37	3/Yr
Sustain (Company)	12	6/Yr	12	3/Yr
Sustain (Plat & Sqd)	42	4/Yr	42	3/Yr
Support (Company)	56	5/Yr	56	3/Yr
NBC	19	5/Yr	19	3/Yr
MOUT	16	3/Yr	16	2/Yr
Other				
Bn FTX	72	1/Qtr	72	1/Qtr
Bn Battle Simulation	72	1/Mo	72	1/Mo
Div FTX	72	1/Yr	72	1/Yr
Bde FTX	72	2/Yr	72	2/Yr
Bde Battle Simulation	72	1/Qtr	72	1/Qtr
AGI	1 Week	1/Yr	1 Week	1/Yr
AGI Spot Check	1 Day	1/Yr	1 Day	1/Yr
COMET (Maintenance Inspection)	1 Week	1/Yr	1 Week	1/Yr
NCO Development	4	1/Mo	4	1/Mo
A & R	4	1/Wk	4	1/Wk

b. Conclusions - These programs have been formulated based upon the opinions of 269 officers or NCOs who occupy or have recently departed leadership or key staff positions in Mechanized Infantry or Armor battalions. Although imperfect, they represent the best data on the precise training requirements for the Mechanized Infantry/Tank task force available in the Army today.





Prescriptive Training Resource Model

	TIME						DOLLARS			PEOPLE	
TYPE UNIT	TRAINING DAYS	TRAINING YEAR	MAINTENANCE DAYS	MAINTENANCE YEAR	NON-TRAINING DAYS	NON-TRAINING YEAR	P2	CL V	TURB	NPFT**	FILL***
SET IA	213	84%	40	16%	0	0%	516K	2400K*	35%	25%	85%
Current[B] MECH FORSCOM	113[C]	44%	54	21%	92	35%	218K	654K*	35%	25%	85%
Current[B] MECH USAREUR	127[C]	50%	51	20%	101	39%[D]	343K	?	35%	25%	85%
SET IIA	141	56%	58	23%	54	21%	396K	1674K*	20%	20%	85%

A- Bn-1 (95%) Readiness
B- Readiness undetermined
C- Includes athletics and recreation (A&R Programs)
D- Exceeded 253 day year
*- Ammunition costs can be reduced by approximately 1/3 by using abbreviated tables, subcaliber and gunnery training devices. Class V data is (QL4).
**- Not Present for Training % per day
***- Officer/NCO Fill

a. Tentative Results - The people, dollars, and time costs for the Set I (High Turbulence, Bn-1 Readiness) and Set II (Low Turbulence, Bn-1 Readiness) programs as well as programs of sample battalions in FORSCOM and USAREUR are outlined above. (QL3)

b. Conclusions

(1) Time

(a) Based on a general approximation of current personnel conditions (35% quarterly turbulence, 85% fill, 25% not present for training), Bn-1 readiness cannot be reached without reducing maintenance time to 16% and nontraining time (Post support, pay day, ceremonies, etc.) to 0% of the duty year, both unacceptable conditions(Set I above). (QL3)

(b) By changing personnel conditions to 20% quarterly turbulence, 20% not present for training and 85% fill, Bn-1 (95%) readiness standards can be reached by devoting 56% of the duty year to training, 23% to maintenance, and 21% to nontraining activities (Set II, table, previous page), percentages that appear tolerable based on "Best Battalion" Costing Program result (see Current Mech FORSCOM and USAREUR, table, previous page). 95% BASELINE TIME ALLOCATION: 56% training, 23% maintenance, 21% nontraining.

(2) People

(a) Turbulence conditions above 20% quarterly (10% quarterly turnover per AR 220-1) must be reduced by DA and subordinate echelons if Bn-1 (95%) readiness standards are to be reached. Turbulence conditions above this will precipitate such high training task frequency requirements that it will lower time available for maintenance and nontraining activities to unacceptable levels. Very low levels of turbulence below this baseline are improbable as they will significantly restrict DA flexibility in addressing such personnel challenges as remote tour equity, officer/NCO professional development and volunteer Army commitments. (QL3)
95% BASELINE TURBULENCE: 20% per quarter.

(b) Not present for training strength in units (Y time; i.e., neither training priority nor post support priority) above 20% daily must be attenuated by DA, MACOM, and division policies and below 20% maintained by units if Bn-1 (95%) readiness standards are to be reached. It is assumed that X time (training priority period) not present for training figures approach 10% and Z time (post support priority period) not present for training figures approach 90%. Conditions above this baseline will precipitate training task frequency requirements that will compromise required maintenance and nontraining activities. Conditions below this baseline will provide units very little flexibility to address sick call, guard details, charge of quarters (CQ), and other like activities. (QL3)
95% BASELINE NOT PRESENT FOR TRAINING STRENGTH: 10%X, 20%Y, 90%Z.

(c) Personnel fill conditions for all grades below 85% full must be attenuated by DA policies and at 85% accommodated by units if Bn-1 (95%) readiness standards are to be reached. Fill conditons below this baseline will cause training task time requirements that will compromise maintenance and nontraining activities.
95% BASELINE PERSONNEL FILL: 85% OFFICER/NCO.

(3) Dollars: Prescriptive monetary requirements to address Bn-1 (95%) readiness standards based on required personnel conditions are outlined on page V-4. Ammunition costs exceed P2 mission costs (primarily POL and Class IX spare parts) by a factor of three. Ammunition costs should be (QL4)

amenable to reduction by approximately one-third by using abbreviated gunnery tables and subcaliber and other gunnery simulator devices during marksmanship programs. The degree of substitution acceptable to a unit at Bn-1 and lesser levels of training readiness must be verified by subsequent analysis and test (see TEA Summary Volume).

(4) Summary:

(a) It is reassuring to compare current dollars, people, and time resources being utilized by FORSCOM and USAREUR units and those which are required for Bn-1 readiness (95%). With tough but viable policy changes, (QL3) the Army can reach this high but necessary readiness posture. If DA policies can attenuate turbulence from 35% to 20% (reduction of quarterly turnover rate from 17.5% to 10%)and MACOMs, divisions, and units can implement policies that ensure not present for training strengths of 10%, 20%, and 90% for X, Y, and Z time, respectively, and reduce nontraining time activities by 15% and 18% for FORSCOM and USAREUR units, respectively, Bn-1 (95%) readiness is attainable. This statement presumes that the prescribed dollar requirements are provided by OSD, OMB, and the Congress.

(b) Dollar requirements are generated by time requirements to reach Bn-1 (95%) readiness standards. Time requirements in turn are driven by personnel conditions. Based on analysis of the preceding paragraphs, dollars cannot fully compensate for time or personnel resource shortfalls. Time can compensate for dollar resources by stretching out (QL3) training programs, but it cannot compensate for personnel resources without bankrupting maintenance and nontraining time requirements. Personnel, accordingly, is the resource of preeminent importance. It follows that when dollars are arbitrarily reduced, time (field training days) must be reduced. If personnel conditions cannot be improved to reduce training task frequency requirements, readiness will fall; the decrement can be approximated by the BTM. Likewise, if training time is reduced (ostensibly for nontraining activities such as Reserve Component assistance training, post support, etc.), only personnel conditions can make up the discrepancy. The personnel community will be operating with difficulty to ensure 10% quarterly turnover, 85% officer/NCO fill and 20% not present for training conditions due to continuing obligations to professional development, remote tour equity and Volunteer Army recruitment commitments. Therefore, it appears likely that any arbitrary dollar or time reduction will be matched with a virtually certain training readiness reduction. The degree of anticipated readiness reduction can be approximated by the BTM.

Prescriptive Costing Methodology:

Tentative results and conclusions for the costing methodology required to support descriptive training programs and the prescriptive training resource model outlined above are included in Annex O. A distillation of the requirements of that methodology are outlined below:

a. Training requirements. Precise requirements in the form of battle/training drills by number and type are determined by ARTEP diagnostic evaluation and commanders' judgements using the descriptive training program outlined above as a guide.

b. People requirements. Turbulence, turnover, fill, and present for training percentages can be predicted and tailored to provide the most effective and efficient training environment for the period of the training schedule being addressed for programming and budgeting.

c. Time requirements. Based on training requirements and personnel conditions, the time and frequency requirements for battle/training drills and other training (ARTEPs, FTXs, battle simulations, etc.) are developed. These times and frequencies are translated into requirements for number of training days by type day in consonance with the following listing:

TYPE TRAINING DAYS

Line Companies	Battalion Headquarters
Small Unit FTX	Battalion Level FTX
Battalion Level FTX	Multiechelon ARTEP
Multiechelon ARTEP	Tactical Exercise w/o Troops
Mission Training	Command Post Exercise
Garrison Training	Mission Training
Heavy Mortar Platoon	**Other Platoon/Team**
Platoon Field Training	Platoon/Team Field Training
Battalion Level FTX	Battalion Level FTX
Multiechelon ARTEP	Multiechelon ARTEP
Mission Training	Mission Training
Garrison Training	Garrison Training

d. Dollar requirements. These requirements embrace parts, POL, ammunition, and other fixed and variable costs as listed on the next page.

(1) Spare parts and POL. Miles per type vehicle per type day are determined. These derivations are applied to dollars per mile cost factors (POL and spare parts) determined for each installation. A similar system is used for other items of equipment except hours of operation factors (radios, generators, etc.) are used in place of miles. Total parts and POL dollars are determined by:

$$\text{No. type days} \times \frac{\text{miles}}{\text{type day}} \times \frac{\$}{\text{mile}} = \$; \quad \text{A+B+C type day } \$ = \text{Total } \$$$

(2) Ammunition. Ammunition requirements per type battle/training drill are projected in accordance with dollar ceilings established by higher headquarters and accounted for through the training ammunition management information system (TAMIS) once it is implemented. Projections are based on codified allocations by type of ammunition for each battle/training drill as refined by the local commander based on his own estimate of his situation.

(3) Other dollar costs. These costs are represented by such items as quarterly droppage, web gear wear and tear, and batteries for the M70 TOW trainer associated with training activities. The comprehensive and diverse nature of these cost categories mandate that they be handled on a case-by-case basis.

Recommendations.

a. Descriptive Training Programs.

(1) HQ TRADOC (ARTSG) develop and administer one additional Mechanized Infantry/Tank Task Force Survey designed to conform with expanded sampling of critical values and/or relationships for the BTM. This survey should be applicable for combat support unit use (Artillery, Air Defense Artillery, Engineer).

(2) HQ TRADOC sponsor the following BTM coordination meetings during First Quarter 1979 (meetings ongoing with routine staffing in TRADOC).

(a) Conference between the Armor and Infantry Schools, Army Training Board, and ARTSG to evaluate battle/training drill and type training day concept and to develop a detailed BTM implementation plan.

(b) Meetings with MACOMs to coordinate concepts and recommendations developed at conference above.

(3) HQ TRADOC expand following documents in manner indicated during FY 1979:

(a) ARTEP Training and Evaluation Outlines. Modify to include individual and collective tasks and battle/training drill elaborations of ARTEP missions as established in current ARTEP 71-2.

(b) Commanders' Manuals. Modify to indicate frequency of repetition of battle/training drills for maximum multiechelon, integrated training; list high decay skills (Annexes E & J); and recommend program decrementing alternatives for varying resource decrementing levels.

(c) TC 21-5-7. Explain battle drill system evolution as well as recommended guidance on planning and execution of priority period training.

(d) FM 71-1 and 71-2. Modify to provide examples of battle drills and specific tactical dispositions, conditions and tactical purposes related to team/task force tactical doctrine.

(4) HQ TRADOC (ARTSG) in coordination with MACOM prepare draft readiness keyed training programs for units scheduled for one, five, ten, twenty, and thirty days of predeployment training (see Chapter IV).

b. Prescriptive Training Resource Model.

(1) BTM analysis poses significant general personnel policy issues. These issues should be evaluated by the responsible agency as a matter of priority:

(a) HQDA review implications of improved assignment policies which will precipitate 10% quarterly turnover (20% turbulence), 85% fill for officer/NCO grades and 20% daily not present for training strength.

(b) HQDA explore desirability and feasibility of expanding installation TDAs or other comparable measures for high priority units to reduce not present for training requirements placed on those units.

(c) HQ TRADOC (ARTSG) corroborate ARTS data and model building methodology and provide BTM sensitivity analysis support to HQDA to demonstrate over-riding impact which personnel conditions have on training time and readiness.

(2) HQ TRADOC conduct follow-on ARTSG TEA '79 & '85 program to:

(a) Refine survey-derived time, dollar, and people costing data currently factored in BTM.

(b) Determine training proficiency as a function of frequency of repetition.

(c) Provide data on training proficiency and relative costs as a function of subcaliber and gunnery training devices.

c. Prescriptive Costing Methodology: HQDA adopt common costing methodology outlined in Annex O.

d. Further BTM Developments.

(1) HQ TRADOC sponsor a conference between HQDA, TRADOC and Operating Commands to discuss the proponency and direction BTM short- and long-range follow-on efforts during October 1978. The conference should:

(a) Consider Concepts and Analysis Agency (CAA) as proponent for BTM program capable of addressing high level policy issues on a large research type computer (see Annex P).

(b) Consider TRASANA as proponent for BTM program capable of addressing unit training management issues on an IBM 5100 computer (see Annex Q).

(c) Consider Army Training Board as proponent for BTM program capable of laying out descriptive training programs for field use.

(d) Consider ODCSOPS as overall proponent to coordinate recommendations described above.

(2) In addition to actions recommended in paragraph a above, HQ TRADOC (ARTSG), by 1 April 1979:

(a) Validate individual/collective task integration factors outlined in Annexes F through I.

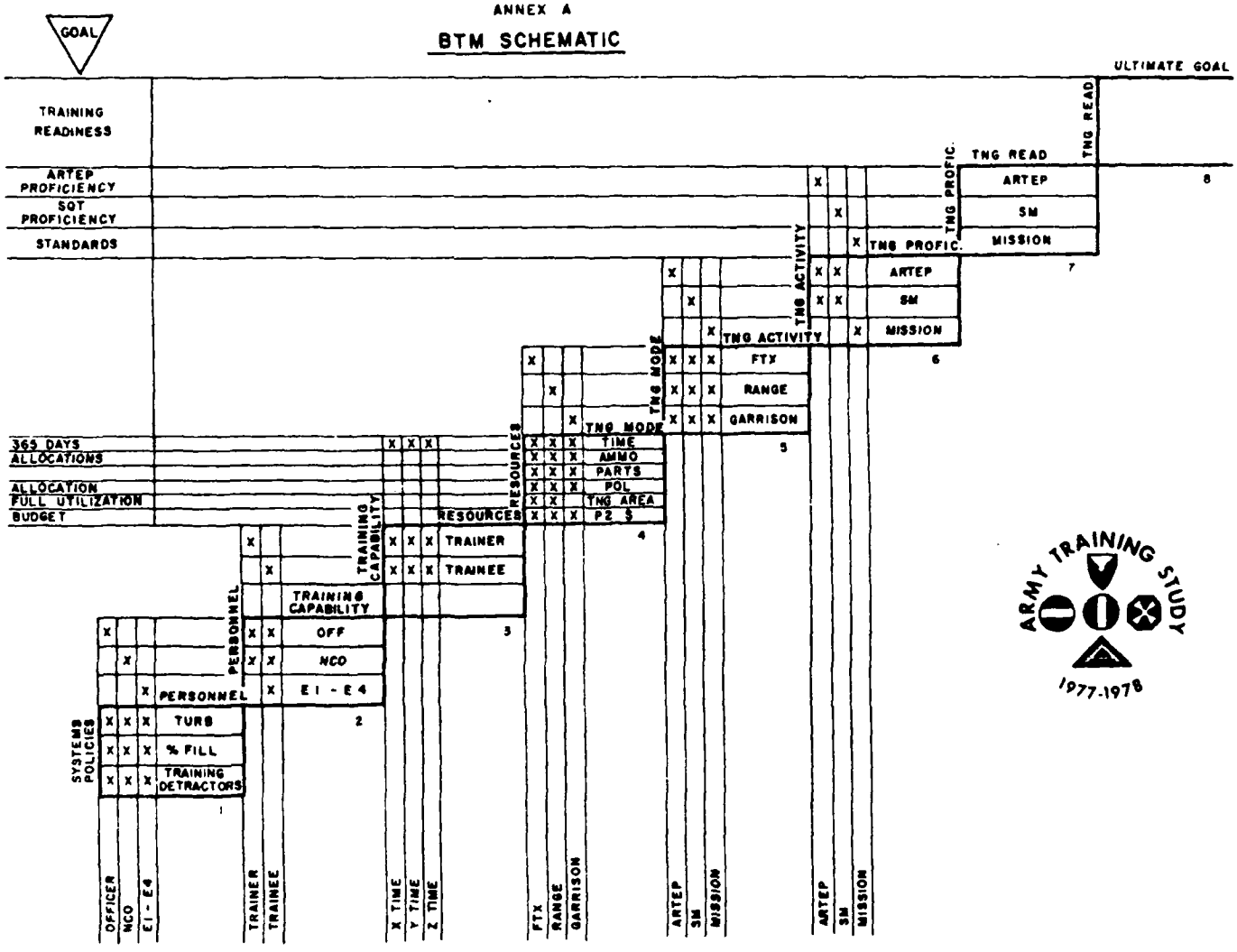
(b) Review current Mechanized Infantry/Armor data and relationships for applicability to RC units and correct survey data with TEA '78 results.

(c) Refine the integration - training program relationships to align with the remainder of the program, develop the training area relationship and refine the equipment availability formulation in the BTM.

(d) Reconfigure the BTM for field validation.

ANNEX A

BTM SCHEMATIC



ARMY TRAINING STUDY

1977-1978

ANNEX B

"BEST BATTALION" COSTING PROGRAM

Introduction

This annex outlines the procedures used to develop the data outputs of the best battalion costing program. The purpose of the program was to assemble data relating to the training conducted by a high performance Armor battalion in CONUS and USAREUR as well as a high performance Mechanized Infantry battalion in CONUS and USAREUR. The data provided insights for the development of the training programs included in the BTM. Additionally, a significant portion of the cost data incorporated into the BTM were outputs of the best battalion costing program. The collection effort focused on three general data categories; training activities, personnel conditions, and training costs. A recapitulation of the data collected follows the discussion of the data collection methodology.

TRAINING ACTIVITIES

General

One year's training schedules (May 1977 - April 1978) for each of the units examined were analyzed to develop a time distribution of scheduled activity. In cases where the training schedules were missing or ambiguous, training calendars, master activity schedules, and training activity reports were used to fill in gaps. Data was developed for a company sized unit, since this is the level at which training schedules are prepared. The following decision rules were applied:

. Training times were recorded for the line companies on the assumption that training for the headquarters and headquarters company (HHC) and combat support company (CSC) could be conducted within the overall time limitations of the line companies. However, high cost training conducted in HHC and CSC were recorded as separate, nonadditive entries. An example of such training is that conducted by the combat support platoons of the CSC.

. Training schedule entries frequently indicated one activity for "company (-)" and other activities for "selected personnel." In consonance with normal training schedule preparation procedure, the "company (-)" entry was taken as the company's primary activity and so recorded. Entries for "selected personnel" were recorded only for those cases where they represented cost-sensitive activities such as weapons firing.

Times were recorded to the nearest half-hour. It should be noted that some training days did not specify a full 8 hours of scheduled activity. Meal times were not counted. An activity which took an entire day or

longer, such as an FTX, was recorded in days. To convert hours to days, hours were divided by eight and rounded to the nearest day. To compute percent of time by category, a percentage was calculated for each company and simple averages taken of the three companies by category.

Description of Activity Categories

Maintenance. Includes all time specifically identified for maintenance of all types of equipment to include motor stables and Equipment Serviceability Criteria checks (ESCs). The total for this category may understate the hours actually performed; as maintenance time scheduled for "selected personnel," which was a common entry, was not recorded.

SM Training. Includes time identified as soldier's manual training. Also includes squad level training where the reference listed was the "CAT B Training Package." It is possible that some hours of squad collective training were picked up in this category since in some cases it was impossible to determine whether the squad level training was on individual or collective tasks.

SQT Training. It is recognized that this represents the same type of training as the category "SM training"; however, because concern has been expressed over the amount of time units spend specifically in preparation for the SQT, and it was so identified on the training schedules, it was treated as a separate category. SQT training includes:

SQT Preparation
Practice SQT Test (HOC)
SQT Testing
SQT Review

ARTEP - Garrison. This category includes ARTEP-related training conducted in garrison, both classroom and company area.

Battalion FTX. Includes time identified on training schedules as battalion level FTX. In some cases, a judgment had to be made as whether the activity was conducted at battalion level, at company, or below. Additionally, unless explicitly scheduled otherwise, all major training area (MTA) time for the two USAREUR battalions was categorized as battalion FTX time. Preparation for, and the conduct of, battalion ARTEPs was also included in this category.

Company FTX. Includes time identified on the training schedule as company level FTX. This category would include platoon and squad collective training when conducted with the entire company in the field. It also includes company ARTEP training and an aggregation of subunit evaluations.

Mission Training. This category addresses mission-related training which is exclusive of SM/ARTEP tasks. Included are such activities as: emergency

deployment readiness exercises (EDRE), ammunition up-load exercises, civil disturbance training, and alert ready force (ARF) commitments. The time shown for this activity may be understated due to the manner it appeared on the training schedules. On occasion, time for a given type mission requirement was scheduled for the entire company, and thus was recorded as the company's principal activity. On other occasions, it appeared as involving only "selected personnel" and was therefore, not recorded.

Tank Gunnery. Time in this category is limited to range time. Classroom-type gunnery instruction time was recorded with SM time.

NonSoldier's Manual Training. This category includes general subjects required/desired for the individual soldier but not related to soldier's manual/ARTEP tasks. The following are some examples of such subjects:

Code of Conduct
Human Relations/Equal Opportunity
Military Justice
Geneva/Hague Convention
Crime Prevention
Drown Proofing
Service Benefits
Unit History

Other. Included in this category are collective activities which do not relate to ARTEP training, as well as entries not specific enough to categorize elsewhere. This category includes:

Preparation for Organization Day/Week
Organization Day/Week
People's Day Activities
Payday Activities
Change of Command Ceremonies
Training Holidays
Compensatory Time
Commander's Time
Physical Training*
Athletics and Recreation*
Unit Inspections
Annual General Inspection
Inventories of Equipment
Preparation for Inspection
Preparation for Overseas Movement (POM)
Records Update
Unit Parties
German-American Activities
Adventure Training (Skiing, Mountain Climbing)

*Subsequent to the completion of the best battalion costing program ARTS established a specific training category to accommodate A&R and physical training actvities.

Unit Personnel Conditions

The unit personnel conditions addressed by the best battalion costing program are: percent officer/NCO fill, percent of turbulence within the battalion per quarter, percent not present for training (NPFT), and battalion operating strength as a percent of TOE authorization. With the exception of NPFT, the data was derived from monthly personnel data summaries. Monthly turbulence was assumed to be twice that shown for monthly turnover. Averages of the monthly data were taken to allow for the display of the personnel conditions by quarter.

The NPFT figures for the CONUS Armor battalion were developed from an analysis of available daily present for training reports in conjunction with the unit's training schedules. Daily present for training reports were not available for the CONUS Mechanized Infantry battalion. The data shown for the battalion was derived from not present for training records of another Mechanized Infantry battalion in the same brigade. It was assumed that both battalions would have relatively similar histories of not present for training strength.

Daily not present for training records were not available in USAREUR. The NPFT figures shown for the two battalions were based on a combination of unit after action reports and ARI data. These sources did not provide sufficient depth of information to permit the estimation of other than X (prime training) time figures.

Unit Training Costs

The cost of the unit training conducted by the four battalions was based on an aggregation of the costs of the different type training days identified as being cost sensitive.

Having broken down the unit training schedules into days of various type activities, the next step was to develop cost factors for each type day. The methodology for both CONUS and USAREUR was to use available data which pro-rated POL and spare parts costs to miles driven by type vehicle. These factors were then multiplied time the miles driven (by type vehicle) on a particular type of training day and by the number of vehicles involved in that type activity. In other words:

$$\frac{\$\ (\text{POL} + \text{Spare Parts})}{\text{Miles}} \times \frac{\text{Miles}}{\text{Vehicle}} \times \frac{\text{Vehicles}}{\text{Type Day}} = \$/\text{Type Day}$$

Finally, the number of days by type was multiplied by the cost factor and summed for the cost of the training program. The particulars of how this was done varied somewhat between CONUS and USAREUR.

CONUS costs were developed using the FORSCOM TMCS (P2 Mission) Model. For the battalions examined, worksheets were developed listing the number of vehicles by type and average miles driven for each type training activity. Miles driven was estimated by the units. The worksheets were submitted to FORSCOM for processing by TMCS. The dollar output was then divided by the number of training days reflected on the worksheets to come up with a cost per day.

Costs for the USAREUR battalions were developed from the V Corps Program Development Handbook (Draft). The data for the handbook was collected from 31 V Corps battalions, including the two battalions examined by ARTS. The handbook provides cost per mile by type vehicle. Other data collected from exercise cost feeder reports provided miles per type vehicle by each type training activity.

A recapitulation of the data assembled from the best battalion costing program is displayed on the following pages.

	EUROPE		CONUS	
	TK Bn	Mech Bn	Mech Bn	TK Bn
Maintenance	55	51	54	84
SM Training	19	16	15	12
SQT Training	7	13	12	5
ARTEP Garrison	10	1	7	0
BN FTX	27	66	26	7*
(MTA)	(21)	(42)		
CO FTX	0	20	18	12*
Mission	9	1	8	0
TK Gunnery (MTA)	35	-	-	25
Non-SM	8	10	7	10
Other	89**	101**	112**	116**
	259	279	259	274

Table 1. Time Utilization in Days (QL-3)

*These figures may not reflect the total number of days of field training conducted. Twenty-five days of field support (included in "other") to OTEA may have afforded the unit the opportunity to conduct additional field training.

**Figure includes time devoted to physical training and athletics and recreation (A&R). Subsequent to the completion of the best battalion costing program, however, ARTS established a specific training category to accommodate A&R and physical training activities.

	EUROPE		CONUS	
	TK Bn	Mech Bn	Mech Bn	TK Bn
Maintenance	21%	18%	21%	31%
SM Training*	7	6	6	4
SQT Training*	3	5	5	2
ARTEP Garrison**	4	0	3	0
BN FTX**	10	24	10	***3
(MTA)	(8)	(24)	-	
CO FTX**	0	7	7	***4
Mission	3	0	3	0
Tank Gunnery (MTA)*	14	-	-	9
NonSM	3	4	3	4
Other	35	36	43	42

Table 2. Distribution of Time by Percent (QL-3)

* Individual SM Training

** Collective Training

***This figure may not reflect the actual percent of time spent on collective training. Twenty-five days of field support to OTEA may have afforded the unit the opportunity to conduct additional collective training.

QUARTER	% OFF/ NCO FILL	% QUARTERLY TURBULENCE	% NOT PRESENT FOR TRAINING			OPN STR AS % OF AUTH STRENTGH
			X Time	Y Time	Z Time	
CONUS Armor Battalion						
Apr-Jun 77	95	16	29	50	84	127
July-Sep 77	93	26	29	50	84	121
Oct-Dec 77	88	26	29	50	84	112
Jan-Mar 78	84	20	29	50	84	101
CONUS Mechanized Battalion						
Apr-Jun 77	91	25	31	43	58	104
July-Sep 77	90	41	31	43	58	99
Oct-Dec 77	87	25	31	43	58	96
Jan-Mar 78	76	23	31	43	58	97
USAREUR Armor Battalion						
Apr-Jun 77	84	20	15*			99
July-Sep 77	84	16	15			99
Oct-Dec 77	84	18	15			97
Jan-Mar 78	84	16	15			98
USAREUR Mechanized Battalion						
Apr-Jun 77	76	24	30			89
July-Sep 77	76	28	30			87
Oct-Dec 77	76	22	30			89
Jan-Mar 78	76	14	30			94

Table 3. Personnel Conditions (QL-3)

*USAREUR percent for red + yellow times undetermined.



BN LEVEL CLASS III & IX COSTS

	$000
TANK BN - EUROPE	384
MECH BN - EUROPE	343
MECH BN - CONUS	218
TANK BN - CONUS	380

Table 4. Battalion Level Class III and IX Costs (QL-3)



ANNEX C

SENSITIVITY FACTORS

- Full Combat Ready (95%) - Combat Ready (85%) - Marginally Combat Ready
- Not Present for Training
- Change in Duty Position
- Grade Substitution
- Training vs Retrain Time
- Retrain Time Interval
- CAT IV vs CAT III
- Inconsistent Trainee Capability
- Decrementing Priorities - Individual vs Collective
- Integration
- Maintenance Training vs Maintenance
- Night vs Day Training

ANNEX D

ARMOR & INFANTRY SCHOOL'S LETTERS

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY ARMOR CENTER AND FORT KNOX
FORT KNOX, KENTUCKY 40121

ATSB-ARTS

22 MAY 1978

SUBJECT: Review of ARTSG Battalion Training Model Survey

Brigadier General Frederic J. Brown
Director, Army Training Study Group
Fort Belvoir, VA 22060

1. Reference CONUS and USAREUR battalion training model surveys for the mechanized infantry/tank task force prepared for the Army Training Study Group.

2. The US Army Armor Center has reviewed the referenced documents (surveys) and concurs with them as written. It is our understanding that this survey has already been administered to units in both CONUS and USARUER.

3. The product established from the results of this survey, i.e., the battalion training model is of interest to the armor community, therefore request the Armor Center be kept informed of its developments.

THOMAS P. LYNCH
Major General, USA
Commanding

DEPARTMENT OF THE ARMY
UNITED STATES ARMY INFANTRY SCHOOL
FORT BENNING, GEORGIA 31905

IN REPLY REFER TO

8 JUN 1978

ATSH-I-V-A-S

Brigadier General Fredrick J. Brown
Director
United States Army Training Study
Fort Belvoir, Virginia 22060

Dear General Brown:

The Battalion Training Survey indicates that a lot of good work has been done in quantifying the highly complex and elusive area of training resources and resulting proficiency.

My training developers and evaluators have completed an indepth review and have unanimously agreed with the concepts and categorizations of topics as presented in the questionnaire. The necessity of a lengthy and complex questionnaire is acknowledged due to the severe time constraints your group is working under. For future use in validating and completing input to the battalion training model, it is suggested that the questionnaire be simplified by correlating tactical training questions to the levels at which they are trained and tested in the ARTEPS. The magnitude of the questionnaire may be reduced by segmenting the questionnaire into parts to be administered separately, and by simplifying the scoring procedures for respondents.

We have a vested interest in the survey results and welcome the forthcoming results. The offer of having the advance course students available for the purpose of administering a survey, as stated to Colonel Burba during his recent visit, is still open. The Infantry School continues to make every effort to support this very important effort.

Sincerely,

WILLIAM J. LIVSEY
Major General, USA
Commandant

ANNEX E

Battle/Training Drill Formulations

1. Outlined on the following pages are the details on how the Shoot, Move, Communicate, Fire and Maneuver, Reconnaissance and Security, Battle Positions, Sustain, Support, NBC and MOUT battle/training drills are formulated.

2. Section I and Section II of each formulation display the individual and collective tasks that were aggregated to form the battle/training drill. Section III displays the times and frequencies of each individual and collective task and the aggregated time and frequency for the battle/training drill under analytical baseline conditions (85 percent officer/NCO fill, 35 percent quarterly turbulence and 25 percent daily not present for training) prior to integration and after integration. Note that in many cases a single time and frequency entry is made for an aggregation of two or more individual tasks. Further, note that high decay tasks that require additional training in addition to that gained during the battle drills are earmarked for the additional frequencies of repetition required. Normally, this applies only to the individual tasks but, in some cases such as leader training in the Support Battle Drill, it applies to other tasks as well.

3. Section III further displays the aggregated time and frequency for the battle/training drill under the 95 percent baseline conditions (85 percent officer/NCO fill, 20 percent quarterly turbulence, and 20 percent daily present for training) after integration factors have been applied. The times and frequencies of the battle/training drills for the program will fit into the normal Army duty year (253 days) with 56 percent of the time (141 days) for training, 23 percent of the time (58 days) for maintenance, and 21 percent of the time (54 days) for non-training activities.

4. Section IV of each formulation outlines the tactical dispositions, conditions, and purposes which make up the tactical problems for each drill. This part provides the grist for an elaboration on how to train to ARTEP tasks, conditions, and standards thru the medium of battle/training drills in TC 21-5-7 and a detailed discussion on how they are formulated in the Commander's manual (i.e., FM 7-11 B/C/CM).



Battle/Training Drill - Move

SECTION I

.Primary Collective Task	Level	Time	Frequency
Tactical Movements	Squad	5.6	7
	Platoon	6.7	7
	Company	7.2	6

.Primary Collective Task Component

Combat loading
Organization
Conduct of movement
Techniques of movement
  Travelling
  Travelling overwatch
  Bounding overwatch
  Terrain driving - kill zones, suppression zones
  Recovery
  Water movement
  Dismounted
  Limited visibility
  Action when disabled

.Reinforcing Collective Tasks Frequency Credit - Annex F



Battle/Training Drill - Move

SECTION II

. Individual Skills - Mech	Time	Frequency
*Start and Stop M113A1 *Operate M113A1 *Prepare M113 for Towing	2.8	11
Self Recovery Ford Water Obstacle Extinguish Fire	3.1	4
Operate 1/4 Ton	2.2	8
Self Recover 1/4 Ton	2.5	3
Ford Water Obstacle		
TOTAL	10.6	8

. Individual Skills - Armor	Time	Frequency
**Start and Stop Tank Engine **Operate a Tank **Recover a Tank **Prepare Tank for Towing **Mounted and Dismounted Movement	5.5	18
Extinguish Fire in Tank	1.1	4
	6.6	7

*High Decay Individual - Mech
**High Decay Individual - Armor



Battle/Training Drill - Move

SECTION III

. Initial Battle/Training Drill

	Mech		Armor	
	Time	Freq	Time	Freq
Ind/Sqd/Plt Drill	22	7	19.3	7
Company Drill	7	6	7.0	6
*Additional High Decay Ind.	3*	4*	5.5**	11

. Final Battle/Training Drill

(Analytical Base)

	Mech		Armor	
	Time	Freq	Time	Freq
Ind/Sqd/Plt Drill	22	4	To be determined after 8 August 78	
Company Drill	7	1		
Additional High Decay Ind.	3	4		

. FinalBattle/Training Drill
(95 percent Baseline)

	Time	Freq
Ind/Sqd/Plt Drill	22	3
Company Drill	7	1
High Decay Ind.	3	4

*High Decay Individual - Mech
**High Decay Individual - Armor



Battle/Training Drill - Move

SECTION IV

.Purposes

Administrative Movement
Movement to Contact
Breaking Contact
Primary to Alternate/Supplementary Positions
Counter Attack
Withdrawal
Passage Lines

.Dispositions: Drills embrace moving in one of the following formations and reacting to situation described by the tactical conditions and purposes described below.

Travelling
  Tank leading
  Infantry leading
Travelling overwatch
  Tank leading
  Infantry leading
Overwatch
  Tanks support by fire
  Infantry support by fire

.Tactical Conditions

ACTION	PLUS	TERRAIN	PLUS	OBSTACLES	PLUS	ENEMY
Right		Cleared Areas		Defile		Air Attack
Left		Woods		Water		Ambush
Front		Roads		Mines		Tank
Rear		Cross Country		Wire		ATGM
		Ridge Lines		Built up Area		
				Other Obstacles		

Battle/Training Drill - Shoot (Mech)

SECTION I

. Primary Collective and Individual Tasks

	Ind		Sqd		Plt		Co	
	Time	Freq	Time	Freq	Time	Freq	Time	Freq
Employ Small Arms	29.7	5	5.7	7	5.5	5	5.3	4
Employ Anti-Tank Wpn	8.3	12	5.9	9	6.9	7		
Employ Mortars	8.9	16	4.9	7	5.5	6		

.Primary Collective Tasks Components

Crew/Unit Drill
Fire Control
Fire Distribution
Massing of Fires
Firing Techniques Under Enemy Pressure
Suppressive Fire
Reconnaissance by Fire
Firing Positions - Temporary, Primary, Alternate, Supplemental
Displacement
Ammunition Resupply

.Reinforcing Collective Tasks Frequency Credit - Annex F



Battle/Training Drill - Shoot (Mech)

SECTION II

. Individuals Skills - Small Arms	Time	Frequency
Cal 50 (Night)	2.9	4
Cal 50 (Day)	2.8	5
45 Cal	2.3	3
M60	3.1	5
Hand Grenades	2.1	3
Grenade Launcher	2.5	4
LAW	2.6	5
M16	4.1	5
M16 (Night)	2.8	4
Claymore	1.9	3
90mm	2.6	6
TOTAL	29.7	5

. Individual Skills - Antitank	Time	Frequency
Maintain TOW Weapons		
Load, Unload, Clear TOW	3.6	12
Self Test TOW		
Engage Targets	4.7	7
TOTAL	8.3	12

. Individual Skills - Mortars	Time	Frequency
Place Mortar into Action	8.9	16
Boresight		
Perform Safety Checks		
Lay for Deflection and Elevation		
Prepare Ammunition for Firing		
Remove a Misfire		
Refer Sight and Realign Aiming POSTS		
Reciprocally Lay Mortar		
Traversing and Searching Fires		
Ground Mounted Firing		

Battle/Training Drill - Shoot (Mech)

SECTION III

.Initial Battle/Training Drill	Time	Frequency
Company (-) Ind/Sqd/Plt	40.9	6
Company (-) Company Drill	5.0	4
Antitank Ind/Sqd Sect	21.0	8
Antitank High Decay	8.0	4
Mortar Ind/Sqd Sect	19.0	8
Mortar Ind High Decay	9.0	8

.Final Battle/Training Drill (Analytical Base)	Time	Frequency
Company (-) Ind/Sqd/Plt	40.9	4
Company (-) Company Drill	5.0	4
Antitank Ind/Sqd Sect	21.0	5
Antitank High Decay	8.0	4
Mortar Ind/Sqd Sect	19.0	5
Mortar Ind High Decay	9.0	8

.Final Battle/Training Drill (95 percent Baseline)	Time	Frequency
Company (-) Ind/Sqd/Plt	40.9	3
Company (-) Company Drill	5.0	3
Antitank Ind/Sqd Sect	21.0	5
Antitank High Decay	8.0	4
Mortar Ind/Sqd Sect	19.0	5
Mortar Ind High Decay	9.0	8

Battle/Training Drill - Shoot (Armor)

SECTION I

.Primary Collective and Individual Tasks

	IND		SQD*		PLT*		CO*	
	Time	Freq	Time	Freq	Time	Freq	Time	Freq
Employ Tanks	27	7	15.6	8	16.4	6	16.6	5

.Reinforcing Collective Tasks Frequency Credit - Annex F

SECTION II

		TIME	FREQUENCY
**	Boresight Perform Prepare Fire Checks Load Main Gun Perform Misfire Procedures Perform After Fire Checks Unpack Ammunition Store Ammunition Maintain Ammunition	4.3	9
**	Conduct of Fire Use Battlesight Apply Burst on Target Use Precision Fire Adjust Fire From Subsequent Cmd	5.6	12
**	Load and Clear Coaxial MG Apply Immediate Action Boresight MG	2.4	19
	Firing MG	2.8	5
	Firing M3A1 Sub-Machine Gun	2.3	3
	Firing Cal 45 Pistol	2.3	3
	Night Firing	7.0	5
		26.7	7

*Summation of Employ Small Arms and Antitank + 25 percent Night Training Time

**High Decay Individual - Armor



Battle/Training Drill - Shoot (Armor)

SECTION III

.Initial Battle/Training Drill	TIME	FREQUENCY
Ind/Crew/Plt	59	7
Company Drill	17	5
** Ind High Decay	12	12
*** Mortar Ind/Sqd Sect	19	8
*** Mortar Ind, High Decay	9	8

.Final Battle/Training Drill	TIME	FREQUENCY
Ind/Crew/Plt Drill		
Company Drill		
Ind High Decay	To be determined after 8 August 78	
Mortar Ind, Sqd Sect		

**High Decay Individual - Armor
***Same as Mech Infantry



Battle/Training Drill - Shoot (Mech and Armor)

SECTION IV

. Training Drill - Individual/Crew

Preliminary Qualification Instruction
Qualification Dry Fire
Qualification Live Fire
Collective Employment - Preliminary Instruction and Dry Fire
Crew Drill

. Battle Drill - Initial Dispositions

Travelling
  Tank Leading
  Infantry Leading
Travelling Overwatch
  Tank Leading
  Infantry Leading
Travelling Overwatch
  Tanks Support by Fire
  Infantry Support by Fire

. Battle Drill - Final Dispositions*

Tanks Close, Mounted Infantry in Trail
Tanks Close, Dismounted Infantry in Trail
Tanks Close, Infantry Supports by Fire
Infantry Closes Mounted, Assaults Mounted-Tanks Support by Fire
Infantry Closes Dismounted, Assaults Dismounted, Tanks Support by Fire

. Battle Drill - Tactical Conditions

ACTION	PLUS	TERRAIN	PLUS	OBSTACLES	PLUS	ENEMY
Right		Clear Areas		Defile		Armored Vehicles
Left		Woods		Water		
Front		Built-Up Areas		Wire, Mines		Fortified Position
				No Obstacles		

. Battle Drill Tactical Purpose

Tactical Movement
Fire and Maneuver
Fighting Position
Retrograde Actions
Perimeter Actions

*When adddressing defensive oriented tactical purposes substitute "Tank or Infantry withdrawing" for "Tank or Infantry closing."



Battle/Training Drill - Fire & Maneuver

SECTION I

. Primary Collective Tasks	Level	Time	Frequency
Employ Fire and Maneuver	Squad	7.4	8
	Platoon	7.8	8
	Company	8.0	8
Employ Fighting Vehicles	Squad	5.9	8
	Platoon	7.4	8
	Company	8.5	6
Breach Minefields & Obstacles	Squad	3.7	4
	Platoon	3.9	4
	Company	4.2	4

. Primary Collective Tasks Components

Organization: weapons, individuals, fire team
Functions: weapons, individuals, fire team
Communications
Immediate action control measures
Overwatch Actions
  Observation
  Call indirect fires
  Provide point and area fires
  Rate of fire
  Communications with maneuver element
  Cover flank, rear and front
  Cover and concealment position
Maneuver Actions
  Movement dispositions/formation-tank/infantry
  Target acquisition and identification
  Fire coordination
  Movement routes
  Movement techniques
Breaching Actions
  Suppress enemy
  Conceal breaching area (smoke)
  Secure far side obstacle
  Reduce obstacle

. Reinforcing Collective Tasks Frequency Credit Annex F



Battle/Training Drill - Fire & Maneuver

SECTION II

. Individual Skills	Time	Frequency
Move Mbr Fire Team Move Under Direct Fire React to Direct Fire React to Flares Move Over/Through Obstacles	3.9	8
Select Temporary Vehicle Position	2.2	7
Conceal Mvt by Route Selection	3.3	7
Tank External Phone	1.0	4
Engage Targets (R)*	3.0*	3*
Detect Enemy Mines Locate Mines with Detector Remove Mines with Rope/Grapple	2.3	5
TOTAL	15.7	8

SECTION III

. Initial Battle/Training Drill	Time	Frequency
Ind/Squad/Platoon Drill	49**	8***
Company Drill	21	6
No High Decay Individual	0	0

. Final Battle/Training Drill (Analytical Base)	Time	Frequency
Ind/Squad/Platoon Drill	49	6
Company Drill	21	5
No High Decay Individual	0	0

. Final Battle/Training Drill (95 percent Baseline)	Time	Frequency
Ind/Squad/Platoon Drill	49	4
Company Drill	21	3

*Taught in Shoot Battle Drill
**Summation of times of individual/collective tasks at squad and platoon level.
***Devised by extrapolation of 95 percent confidence limits for frequencies.



Battle/Training Drill - Fire & Maneuver

SECTION IV

. Phasing

Locate enemy
Return fire
Conceal
Report
Develop situation
Deploy
Isolate
Fire
Maneuver
Violent execution

. Initial Dispositions

Travelling
  Tank leading
Infantry leading
  Travelling overwatch
  Tank leading
  Infantry leading
Bounding Overwatch
  Tanks support by fire
  Infantry support by fire

. Final Dispositions

Tanks close, mounted infantry in trail
Tanks close, dismounted infantry in trail
Tanks close, infantry support by fire
Infantry closes mounted, assaults mounted-tanks support by fire
Infantry closes mounted, assaults dismounted, tanks suport by fire
Infantry closes dismounted, assaults dismounted, tanks support by fire

. Tactical Conditions

ACTION	PLUS	TERRAIN	PLUS	OBSTACLES	PLUS	ENEMY
RIGHT		CLEARED AREAS		DEFILE		ARMORED VEHICLES
LEFT				WATER		
FRONT		WOODS		WIRE, MINES		FORTIFIED POSITION
		BUILT-UP AREAS		NO OBSTACLES		
		FORWARD SLOPE				
		REVERSE SLOPE				

. PURPOSES

Fighting Thru
Bypassing
Breaking Contact
Primary to Alternate Positions



Battle/Training Drill - Recon & Security

SECTION I

Primary Collective Tasks	Level	Time	Frequency
Perform Reconnaissance	Squad	5.0	6
	Platoon	5.7	6
	Company	5.3	5
Perform Security	Squad	3.4	5
	Platoon	4.5	4
	Company	5.1	4
Cover & Concealment	Squad	4.8	8
	Platoon	5.8	6
	Company	6.0	5

- Primary Collective Tasks Components
  - Physical Security
  - Signal Security
  - Information Security
  - Tactical Security
    - Cover
    - Concealment
    - Light and Noise Discipline
    - FEBA/TOC/Trains Location
    - Deception Operations
  - Reconnaissance
    - Orient on Location or Movement of the Reconnaissance Objective
    - Report Information
    - Retain Freedom of Maneuver
    - Gain and Maintain Enemy Contact
    - Develop Situation
  - Security
    - Orient on Main Body
    - Continuous Reconnaissance
    - Provide Early Warning
    - Provide Reation Time and Maneuver Space
    - Maintain Enemy Contact

- Reinforcing Collective Tasks Frequency Credit - Annex F



Battle/Training Drill - Recon & Security

SECTION II

Individual Skills	Time	Frequency
Collect/Report Information Prepare a Spot Report Process Captured Documents Process Enemy Personnel Use Challenge & Password	2.5	6
Conduct Day & Night Surveillance	2.9	6
Conduct Surveillance Using AN/PVS-2	2.3	7
Operate an OP	2.5	5
Resist Enemy Interrogation Safeguard Classified Information	1.9	3
Identify Terrain Features Determine Grid Coord Determine Elevation Measure Ground Distance Convert Magnetic Azimuth Determine Grid Azimuth Estimate Range	4.4	6
Orient Map using Compass Orient Map through Terrain Assoc Determine Location on Ground Navigate from one Position to Another Determine Distance between Two Points Determine Azimuth between Two Points *Camouflage and Conceal Self and Ind Equipment *Camouflage and Conceal Equipment *Camouflage and Conceal Defensive Positions	7.1	9
TOTAL	29.3	7

*High Decay Individual Tasks.



Battle/Training Drill - Recon & Security

SECTION III

. Initial Battle/Training Drill	Time	Frequency
Ind/Squad/Platoon Drill	58.5	7
Company Drill	16.0	5
High Decay Individual	2.0	2

. Final Battle/Training Drill (Analytical Base)	Time	Frequency
Ind/Squad/Platoon Drill	58.5	3
Company Drill	16.0	5
High Decay Individual	2.0	2

. Final Battle/Training Drill (95 percent Baseline)	Time	Frequency
Ind/Squad/Platoon Drill	58.5	2
Company Drill	16.0	3
High Decay Individual	2.0	2



Battle/Training Drill - Recon & Security

SECTION IV

. Dispositions
  - Travelling
  - Travelling Overwatch
  - Bounding Overwatch
  - Mounted
  - Dismounted

. Tactical Conditions

Terrain	Obstacles	Objective
Cleared Area	Defile	Reconnoiter Town
Woods	Water	Check Bend in Road
Built-up Area	Mines	Check Bridge
Ridge Lines	Night	Check River
	Smoke	

. Tactical Purposes
  - Route Reconnaissance
  - Zone Reconnaissance
  - Area Reconnaissance
  - Screening mission
  - Guard mission
  - Covering mission

Battle/Training Drill - Communications

SECTION I

. Primary Collective Task -	Level	Time	Frequency
Employ Communications	Squad	3.7	5
	Platoon	4.6	6
	Company	5.5	6

. Primary Collective Tasks Components

Communications Techniques - Collective
- Radio
- Wire
- Expedients - Arm and Hand Signals; Flags, Lights, Panels, Mirrors, Whistles, Pyrotechnics

COMSEC
- Communications During Radio Transmitter Restrictions
- Expedient Authentication
- Messenger Service
- Exedient Wire Usage

Anti-Jamming
- Recognition
- Continuous Operations - Expedient Squelch Usage
- Reporting
- Trim Power
- Antenna Masking
- Mobile Antenna

Combined Arms Communications
- Combat to Combat Support
- Combat to Combat Service Support
- Combat to Naval/Air Force

. Reinforcing Collective Tasks Frequency Credit - Annex F



Battle/Training Drill - Communications

SECTION II

. Individual Skills	Time	Frequency
*Establish and Enter or Leave Net Apply Anti-Jamming Procedures Use Correct RTO Procedures Set up and Use FM Radio	2.0	8
*Install Radio Remote Control Set up and Use Field Telephone TA-IPT Use CEOI	2.6	8
*Authenticate Transmisisons and Encrypt and Decrypt Encode and Decode Messages	2.2	7
	6.8	8

Section III

. Initial Battle/Training Drill	Time	Frequency
Ind/Sqd/Platoon Drill	15.0	3
Company Drill	6.0	4
*Individual High Decay	6.8	2

. Final Battle/Training Drill (Analytical Base)	Time	Frequency
Ind/Squad/Platoon Drill	15.0	3
Company Drill	6.0	4
*Individual High Decay	6.8	2

. Final Battle/Training Drill (95 percent Baseline)	Time	Frequency
Ind/Sqd/Platoon Drill	15.0	2
Company Drill	6.0	3
*Individual High Decay	6.8	2

*Individual High Decay Tasks



Battle/Training Drill - Communications

SECTION IV

- Dispositions: Drills embrace communicating in reaction to tactical condition and purposes while involved in one of the following dispositions:

  Travelling
  - Tanks leading
  - Inf leading

  Travelling Overwatch
  - Tanks leading
  - Inf leading

  Bounding Overwatch
  - Tanks Support by Fire
  - Inf Support by Fire

  Tanks Close, Mounted or Dismounted Infantry in Trail
  Tanks Close, Infantry Supporting by Fire
  Infantry Closes Mounted, Assualts Mounted or Dismounted, Tanks Support by Fire
  Infantry Closes Dismounted, Assaults Dismounted, Tanks Suport by Fire

- Tactical Conditions
  - Tank - Infantry Mounted
  - Tank - Infantry Dismounted
  - Listening Silence
  - Deception
  - Night
  - TACAIR
  - Combat Support & Service Support
  - Rapid Movement
  - Static

- Tactical Purposes
  - Fighting Through
  - Bypassing
  - Breaking Contact
  - Primary to Alternate Positions
  - Passage of Lines
  - Link Up
  - Relief in Place
  - Blocking
  - Holding
  - Withdrawing Route/Zone/Area Reconnaissance
  - Screening/Covering/Guard Mission



Battle/Training Drill - Battle Positions

SECTION I

. Primary Collective Tasks	Level	Time	Frequency
Organize/Prepare Battle Positions	Squad	7.3	6
	Platoon	8.0	6
	Company	9.5	5
Hostile TAC Air Operations	Squad	2.9	5
	Platoon	3.1	5
	Company	4.1	4

. Primary Collective Tasks Components

Organization of Positions
- Mutual Support
- Security
- Capitalize on Fires
- Minimize Exposure (use terrain)
- Defense in Depth/on Flanks
- Control

Techniques
- Avenues of Approach
- Obstacles
- Key Terrain
- Observation
- Fields of Fire
- Sectors of Fire
- Dead Space
- Use of Obstacles

Execution
- Control Fires
- Employ Infantry - Mounted/Dismounted
- Employ Tanks
- Mass Fires
- Employ Reserve

. Reinforcing Collective Tasks Frequency Credit - Annex F

Battle/Training Drill - Battle Positions

SECTION II

. Individual Skills	Time	Frequency
Select Temporary Position		
Construct Individual Position		
Clear Fields of Fire		
*Construct Crew Served Psn.	5.1	9
Prepare/Use Aiming and Firing Stakes		
Construct Range Cards-Crew Weapons		
Camouflage Equipment and Position		
*Install and recover Claymore	1.9	8
Emplace and Recover AP and AT Mines	2.6	4
Identify Minefield Markers		
Assemble Non-electrical System Det.		
Engage Hostile Aircraft	1.7	5
Identify Combat Aircraft	2.0	6
Emplace Demolition Change	2.5	3
	15.8	6

*Individual High Decay



Battle/Training Drill - Battle Positions

Section III

. Initial Battle/Training Drill	Time	Frequency
Individual/Sqd/Plat Drill	37.1	6
Company Drill	14.0	5
Individual Instruction	5.0	3

. Final Battle/Training Drill (Analytical Base)	Time	Frequency
Individual/Sqd/Plat Drill	37.1	4
Company Drill	14.0	5
Individual High Decay	5.0	3

. Final Battle/Training Drill (95 percent Baseline)		
Ind/Sqd/Plat Drill	37.1	3
Company Drill	14.0	3
Individual High Decay	5.0	3



Battle/Training Drill - Battle Positions

Section IV

. Phasing

Understand Enemy
See Battlefield
Capitalize on Advantages
Fight Combined Arms Battles
Be Prepared to Move Rapidly

. Dispositions: Driving

Active Defense Against Breakthrough Effort
Active Defense in Main Battle Area
Economy of Force Defense (One team in MBA)
Economy of Force Defense (Three teams in MBA)
Retention of Terrain
Ambush Operations
Roadblock operations
Occupation of Ground Other Than That to be Defended
Antitank operations

. Tactical Conditions

TERRAIN	OBSTACLES	ENEMY
Cleared Areas	Defile	Armored
Woods	Water	Mechanized
Built-up Areas	Wire, Mines	Hostile TAC Air
Forward Slope	Smoke	Superior Force
Reverse Slope	Night	Inferior Force

. Tactical Purposes

Hasty Defense (Active)
Deliberate Defense (Active)
Strong Point
Delay
Withdrawal
Temporary positions during measured attack and reconnaissance operations

Battle/Training Drill - Sustain

Section I

. Primary Collective Tasks	Level	Time	Frequency
-Employ Cbt Service Spt	Squad	3.7	5
	Platoon	4.7	5
	Company	7.9	6
-Reorganize and Consolidate	Squad	3.1	6
	Platoon	4.1	5
	Company	4.5	5

. Primary Collective Tasks Components

Trains - Organization for Combat

Supply Operations

- Rations
- POL
- Ammunition
- Repair Parts
- Medical Supplies
- Major End Items and Organization Equipment
- Expendables
- Medical Supplies

Maintenance, Recovery and Repair

Personnel Support and Administration

- Medical Aid
- Strength Report
- Personnel Management
- Personnel Services

. Reinforcing collective tasks frequency credit Annex F



Battle/Training Drill - Sustain

Section II

Individual Tasks	Time	Frequency
**Drive Maintenance	3.6	25**
*Weapons Maintenance	14.0	9
Equipment Maintenance	4.0	8
Evacuate Wounded Man (Track)	1.3	4
Apply 4 Life Saving Techniques Apply Burn Measures First Aid for Electrical Shock First Aid for Chemical First Aid for Carbon Monoxide Personal Hygiene Reduce Climatic Injuries Adminster Artificial Respiration	3.0	6
	25.9	7

*Most Excessive (M16, M60, Cal .50, 90mm, .45, M203)
**Individual High Decay



Battle/Training Drill - Sustain

Section III

. Initial Battle/Training Drill	Time	Frequency
Company Drill	12	6
Ind/Sqd/Plat Drill	41.5	7
Individual High Decay Drill	4	18

. Final Battle/Training Drill (Analytical Base)	Time	Frequency
Ind/Sqd/Plat Drill	41.5	4
Company Drill	12.0	6
Individual High Decay Drill	4.0	18

. Final Battle/Training Drill (95 Percent Baselilne)	Time	Frequency
Ind/Sqd/Plat Drill	41.5	3
Company Drill	12.0	3
Individual High Decay Drill	4.0	18



Battle/Training Drill - Sustain

Section IV

- Dispositions

  Training Drills: During Y and Z time (in garrison), maintenance training for weapons, vehicles, equipment, and personnel (first aid/field hygiene) is conducted in a structured manner with all leaders present.

  Battle Drills: During X and Y time the above training is integrated into a realistic combat environment by using the disposition outlined for the Fire and Maneuver, Battle Positions and Recon, and Security Battle Drills.

- Tactical Conditions

  Static
  During Movement
  During Rapid Movement
  As Part of Field Trains
  As Part of Combat Trains
  Recover/supply/feeding/refueling under fire
  Field Expedient Recovery
  Night
  During Reorganization and Consolidation
  Mass Casualties
  Medical Evacuation
  Evacuating and Burying the Dead

- Tactical Purposes

  Fighting Through
  Bypassing
  Breaking Contact
  Primary to Alternate Positions
  Passage of Lines
  Link Up
  Relief in Place
  River Crossing
  Blocking
  Holding
  Withdrawing
  Route/Zone/Area Reconnaissance
  Screening/Covering/Guard Missions



Battle/Training Drill - Support

Section I

. Primary Collective Tasks	Level	Time	Frequency
Employ CS Assets			
	Squad	3.5	5
	Platoon	4.4	5
	Company	6.4	5
	Battalion	8.1	5
		22.4	5
Leader/Commander Tasks	Squad	7.4	9
	Platoon	8.8	9
	Company	8.9	8
	Battalion	8.6	7
		33.7	8

. Primary Collective Tasks Components

Leader/Commander Tasks

TACR - Commander/Leader/Staff capability to integrate weapons systems and combat systems (target acquisition, fire, maneuver, communications, logistics, command and control, etc.)

Troop Leading Procedures

How to Train

Employ Combat Support Assets - Artillery, Engineer, Signal, Maintenance, Air Force Liaison Officers, Participation in Leader/Commander Tasks Above.

. Reinforcing Collective Tasks - See Annex F

Section II

. Individual Tasks - None (Off duty professional development tasks only - Does not impact on Troop Training Time)

Battle/Training Drill - Support

Section III

. Initial and Final Training Drills

	Level	Time*	Frequency*
Initial Drills	Leader/CS	56.1	5
	Leader Only	33.7	3
Final Drills (Analytical Base)	Leader/CS	56.0	5
	Leader Only	34.0	2
Final Drills (95 Percent Baseline)	Leader/CS	56.0	3
	Leader Only	34.0	1

Section IV

. Disposition/Tactical Conditions and Purposes:

This training drill represents Tactical Exercises Without Troops (TEWTs) in the form of terrain model/map exercises, terrain walks and jeep exercises whereby commanders, leaders, and staff officers train themselves in their own tactical skills and learn how to train their troops for the other training/battle drills. This drill is not included in troop-training time; it is included in the leader availability cell of the Battalion Training Model. Disposition, tactical conditions, and purposes embrace all those included in the other battle/training drills.

*Not included in Troop training time. Accounted for in Leader/Training Availability.

Battle/Training Drill - NBC

Section I

. Primary Collective Tasks	Level	Time	Frequency
Employ NBC Techniques	Squad	4.0	7
	Platoon	4.1	6
	Company	4.5	6

. Primary Collective Task Components
- Protection Against Fallout
- Monitoring Radiation Levels
- Radiological Survey
- Protection Against Chemical and Biological Attack
- Detection
- Decontamination
- Damage Control

. Reinforcing Collective Tasks Frequency Credit Annex F

Section II

. Individual Tasks	Time	Frequency
Maintain Protective Mask Put on Protective Mask Take Cover from NBC Hazard Decontaminate Self and Equipment Administer Antidote Measure Radiation	3.5	8
Prepare Track/Vehicle for NBC Maintain Gas Particulate Unit	2.3	6



Battle/Training Drill - NBC

Section III

.Initial Battle/Training Drill	Time	Frequency
NBC Individual and Collective	19.0	6
NBC Individual High Decay	3.5	2

.Final Battle/Training Drill (Analytical Base)	Time	Frequency
NBC Individual and Collective	19.0	5
NBC Individual High Decay	3.5	2

.Final Battle/Training Drill (95 Percent Baseline)		
NBC Individual and Collective	19.0	3
NBC Individual High Decay	3.5	2

Section IV

Dispositions

- Firing
- Moving
- Fire and Maneuver
- Communicating
- Eating
- Maintaining

Tactical Conditions

- Night
- Inclement Weather
- Inverse Conditions
- Wind

Tactical Purposes

- Fighting Through
- Bypassing
- Breaking Contact
- Primary to Alternate Positions
- Passage of Lines
- Link Up
- Relief in Place
- River Crossing
- Blocking
- Holding
- Reconnaissance Mission
- Guard Mission

Battle/Training Drill - MOUT

Section I

.Primary Collective Task

Employ Special MOUT Techniques	Level	Time	Frequency
	Squad	4.9	5
	Platoon	5.3	5
	Company	5.5	4

.Primary Collective Tasks Components

Fire and Maneuver
Movement
Communications
Combat Support
Fire Distribution
Reconnaissance and Security
Combat Service Support
Block and Hold
Clearing Buildings
Techniques of Entering Buildings
APCs and Tanks in Built-Up Areas

.Reinforcing Collective Tasks Frequency Credit - Annex F

Section II

.Individual Tasks - Included in Primary Collective Task per TC 7-1.

Section III

.Initial Battle Drill Package	Time	Frequency
	16	5
.Final Battle Drill (Analytical Base)	16	3

.Final Battle/Training Drill (95 Percent Baseline)	Time	Frequency
	16	2

Battle/Training Drill - MOUT

Section IV

.Tactical Conditions

- Small Villages
- Strip Areas
- Towns and Small Cities
- Large Cities

.Tactical Purposes

- Fighting Through
- Bypassing
- Breaking Contact
- Blocking
- Holding

. Dispositions - Same as Fire and Maneuver, Battle Positions, and Reconnaissance and Security

* A UNIT RECEIVES 1.0, .20 AND .33 FREQUENCY CREDITS FOR PERFORMING TACTICAL MOVEMENTS WHEN PERFORMING THE MOVE, FIRE AND MANEUVER AND COMMUNICATIONS BATTLE DRILLS RESPECTIVELY. COLLECTIVE TASK- BATTLE DRILL INTEGRATION		MOVE	SHOT	FIRE & MANEUVER	RECONNAISSANCE & SECURITY	COMMUNICATE	BATTLE POSITION/HOLD	SUSTAIN	SUPPORT	NBC	MOUT
1. Perform tactical movements	CO	*1.0	.20	*20	*.20	.33	0	.10	0	.20	0
	PLT	1.0	.20	.20	.20	.33	0	.10	0	.20	0
	SQD	1.0	.20	.20	.20	.33	0	.10	0	.20	0
2. Perform security and intelligence operations	CO	.33	.20	.33	1.0	.10	.5	0	0	0	.20
	PLT	.33	.20	.33	1.0	.10	.5	0	0	0	.20
	SQD	.33	.20	.33	1.0	.10	.5	0	0	0	.20
3. Employ cover & concealment	CO	.5	.20	.5	1.0	0	.30	0	0	0	.20
	PLT	.5	.20	.5	1.0	0	.30	0	0	0	.20
	SQD	.5	.20	.5	1.0	0	.30	0	0	0	.20
4. Coordinate & employ non-organic combat support assets	CO	.33	.33	.33	.10	.25	.33	0	1.0	0	.10
	PLT	.33	.33	.33	.10	.10	.33	0	1.0	0	.10
	SQD	.33	.33	.33	.10	.10	.33	0	1.0	0	.10
5. Employ organic small arms	PLT	.10	1.0	.33	.10	.10	.25	.20	0	.20	.10
	SQD	.10	1.0	.33	.10	.10	.25	.20	0	.20	.10
6. Employ fighting vehicles	CO	.33	1.0	.5	.25	.20	.10	.20	0	.20	.10
	PLT	.33	1.0	.5	.25	.20	.10	.20	0	.20	.10
	SQD	.33	1.0	.5	.25	.20	.10	.20	0	.20	.10
7. Employ organic antitank wpns	CO	.10	1.0	.40	.10	.10	.10	.20	0	.20	.10
	PLT	.10	1.0	.40	.10	.10	.10	.20	0	.20	.10
	SQD	.10	1.0	.40	.10	.10	.10	.20	0	.20	.10
8. Employ organic mortars	PLT	.10	.5	.40	.10	.10	.30	.20	0	.20	.10
	SQD	.10	.5	.40	.10	.10	.30	.20	0	.20	.10

COLLECTIVE TASK-
BATTLE DRILL INTEGRATION

		MOVE	SHOOT	FIRE & MANEUVER	RECON & SECURITY	COMMUNICATE	BATTLE POSIT	TIO N/HOLD	SUSTAIN	SUPPORT	NBC	MOUNT
9. Employ fire & manuever/movement	CO	0	.5	1.0	.20	.40	.10	.10	0	.25	.20
	PLT	0	.5	1.0	.20	.40	.10	.10	0	.25	.20
	SQD	0	.5	1.0	.20	.40	.10	.10	0	.25	.20
10. Perform reconnaissance	CO	.33	.20	.35	1.0	0	.20	0	0	.10	.30
	PLT	.33	.20	.35	1.0	0	.20	0	0	.10	.30
	SQD	.33	.20	.35	1.0	0	.20	0	0	.10	.30
11. Reorganize; consolidate	CO	0	.10	.5	.10	0	.5	1.0	0	.10	.30
	PLT	0	.10	.5	.10	0	.5	1.0	0	.10	.30
	SQD	0	.10	.5	.10	0	.5	1.0	0	.10	.30
12. Employ special techniques for operating at night & under limited visibility	CO	.25	.25	.25	.25	.10	.20	.10	0	.10	.25
	PLT	.25	.25	.25	.25	.10	.20	.10	0	.10	.25
	SQD	.25	.25	.25	.25	.10	.20	.10	0	.10	.25
13. Employ special techniques for NBC operations	CO	.20	.20	.20	.10	0	.10	0	0	1.0	.10
	PLT	.20	.20	.20	.10	0	.10	0	0	1.0	.10
	SQD	.20	.20	.20	.10	0	.10	0	0	1.0	.10
14. Employ special techniques for combat in built-up areas	CO	0	0	.10	0	0	0	0	0	0	1.0
	PLT	0	0	.10	0	0	0	0	0	0	1.0
	SQD	0	0	.10	0	0	0	0	0	0	1.0
15. Employ special techniques for operating in a hostile TAC air environment	CO	.25	.10	.20	.20	0	.5	.20	0	0	.10
	PLT	.25	.10	.20	.20	0	.5	.10	0	0	.10
	SQD	.25	.10	.20	.20	0	.5	.10	0	0	.10
16. Employ communications & electronic equipment, incl. wpns in EW environment	CO	.33	.33	.33	.25	1.0	.10	.10	0	.20	.20
	PLT	.33	.33	.33	.25	1.0	.10	.10	0	.20	.20
	SQD	.33	.33	.33	.25	1.0	.10	.10	0	.20	.20

COLLECTIVE TASK BATTLE DRILL INTEGRATION		MOVE	SHOOT	FIRE & MANEUVER	RECON & SECURITY	COMMUNICATE	BATTLE POSI TION/HOLD	SUSTAIN	SUPPORT	NBC	MOUNT
17. Organize and prepare battle positions, including mines & obstacles	CO	0	.10	.10	.10	.10	1.0	.10	0	.10	.25
	PLT	0	.10	.10	.10	.10	1.0	.10	0	.10	.25
	SQD	0	.10	.10	.10	.10	1.0	.10	0	.10	.25
18. Breach mineffelds and obstacles	CO	.10	.10	.5	.10	0	0	0	.5	0	.40
	PLT	.10	.10	.5	.10	0	0	0	.5	0	.40
	SQD	.10	.10	.5	.10	0	0	0	.5	0	.30
19. Employ combat service support (all Admin/log activities)	CO	.20	.10	.10	0	.10	.25	1.0	0	.10	.20
	PLT	.20	.10	.10	0	.10	.25	1.0	0	.10	.20
	SQD	.20	.10	.10	0	.10	.25	1.0	0	.10	.20
20. Perform leader/commander skills	CO	.5	.2	.5	.5	.5	.5	.1	1.0	.2	.4
	PLT	.5	.2	.5	.5	.5	.5	.1	1.0	.2	.4
	SQD	.5	.2	.5	.5	.5	.5	.1	1.0	.2	.4

BATTLE DRILL

SQUAD/PLATOON CREDIT DOUBLED BECAUSE MORE THAN 2 X TIME FOR COMPANY DRILL	ARTEP																			
	MOVEMENT TO CONTACT				HASTY ATTACK				DELIBERATE ATTACK				EXPLOITATION				NIGHT ATTACK			
	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD
MOVE PLT/SQD	.8	1.0	2.0	2.0	.4	.4	.4	---	.2	.4	---	---	.6	---	---	---	.4	.4	---	---
Co.	.8	1.0	1.0	1.0	.3	.3	.3	---	.2	.3	---	---	.4	---	---	---	.2	.3	---	---
SHOOT PLT/SQD	.4	.4	.6	.6	.6	.6	.8	---	.6	.6	---	---	.6	---	---	---	.6	.6	---	---
Co.	.3	.3	.2	.2	.4	.4	.3	---	.4	.4	---	---	.4	---	---	---	.4	.5	---	---
COMMO PLT/SQD	.2	.2	.3	.3	.2	.2	.3	---	.2	.3	---	---	.2	---	---	---	.3	.4	---	---
Co.	.2	.2	.1	.1	.2	.2	.1	---	.2	.1	---	---	.2	---	---	---	.4	.4	---	---
FIRE MANEUVER PLT/SQD	.4	.4	.6	.6	.6	.8	.8	---	.6	.8	---	---	.8	---	---	---	.6	.6	---	---
Co.	.4	.4	.2	.2	.6	.8	.6	---	.6	.8	---	---	.8	---	---	---	.6	.8	---	---
RCN SECURITY PLT/SQD	.4	.4	.5	.5	.3	.3	.4	---	.3	.3	---	---	.3	---	---	---	.3	.4	---	---
Co.	.4	.4	.2	.2	.3	.3	.2	---	.3	.3	---	---	.3	---	---	---	.3	.3	---	---
BATTLE PSN PLT/SQD	.1	.2	.2	.2	.1	.3	.2	---	---	---	---	---	---	---	---	---	---	---	---	---
Co.	.1	.1	.1	.1	.1	.1	.1	---	---	---	---	---	---	---	---	---	---	---	---	---
SUSTAIN PLT/SQD	.1	.1	.2	.2	.1	.1	.1	---	.2	.2	---	---	.2	---	---	---	.1	.1	---	---
Co.	.1	.1	.1	.1	.1	.1	.1	---	.1	.1	---	---	.1	---	---	---	.1	.1	---	---
SPT Co.	.2	.2	.2	.2	.2	.2	.2	---	.3	.3	---	---	.2	---	---	---	.2	.2	---	---
NBC Co.	.1	.1	.1	.1	.1	.1	.1	---	.1	.1	---	---	.1	---	---	---	.1	.1	---	---
MOUT Co.	.1	.1	.1	.1	.2	.2	.2	---	.2	.2	---	---	.1	---	---	---	.1	.1	---	---

BATTLE DRILL - ARTEP INTEGRATION

SQUAD/PLATOON UNDUE TIME ALLOWED BECAUSE MORE THAN 2 X TIME FOR COMPANY DRILL	ARTEP																			
	DEFENSE				DELAY				DISENGAGE				DEFENSE BUILT-UP AREA				STRONG POINT			
	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD
MOVE PLT/SQD	.2	.2	.4	---	.6	.8	---	---	.2	.4	---	---	.2	.2	.2	.2	---	.4	.4	---
Co.	.1	.2	.1	---	.4	.5	---	---	.2	.3	---	---	.1	.1	.1	.1	---	.1	.1	---
SHOOT PLT/SQD	.6	.6	.4	---	.6	.6	---	---	.6	.6	---	---	.4	.6	.8	.8	---	.6	.8	---
Co.	.4	.4	.3	---	.4	.4	---	---	.4	.4	---	---	.3	.4	.3	.3	---	.4	.4	---
COMMO PLT/SQD	.4	.4	.5	---	.4	.4	---	---	.4	.4	---	---	.3	.3	.4	.4	---	.3	.4	---
Co.	.4	.4	.3	---	.3	.4	---	---	.3	.4	---	---	.3	.4	.3	.3	---	.3	.3	---
FIRE MANEUVER PLT/SQD	.3	.4	.5	---	.4	.5	---	---	.6	.8	---	---	.3	.4	.5	.5	---	.3	.4	---
Co.	.3	.6	.5	---	.3	.6	---	---	.6	.8	---	---	.3	.4	.3	.3	---	.3	.4	---
RCN SECURITY PLT/SQD	.4	.4	.6	---	.4	.5	---	---	.4	.4	---	---	.3	.3	.4	.4	---	.2	.2	---
Co.	.3	.4	.3	---	.4	.4	---	---	.3	.4	---	---	.3	.4	.3	.3	---	.3	.3	---
BATTLE PSN PLT/SOD	---	1.8	2.0	---	.4	.5	---	---	.3	.4	---	---	1.6	1.8	1.8	1.8	---	1.4	1.4	---
Co.	---	1.0	1.0	---	.4	.5	---	---	.3	.5	---	---	.8	.9	.9	.9	---	.8	.8	---
SUSTAIN PLT/SOD	.2	.2	.2	---	.2	.2	---	---	.1	.1	---	---	.2	.2	.2	.2	---	.2	.2	---
Co.	.1	.1	.1	---	.1	.1	---	---	.1	.1	---	---	.1	.1	.1	.1	---	.1	.1	---
SPT Co.	.3	.3	.3	---	.1	.1	---	---	.1	.1	---	---	.2	.2	.2	.2	---	.2	.2	---
NBC Co.	.1	.1	.1	---	.1	.1	---	---	.1	.1	---	---	.1	.1	.1	.1	---	.1	.1	---
MOUT Co.	.1	.1	.1	---	.1	.1	---	---	.1	.1	---	---	1.8	2.0	2.0	2.0	---	.5	.5	---

BATTLE DRILL – ARTEP INTEGRATION

SQUAD/PLATOON CREDIT DOUBLED BECAUSE MORE THAN 2 X TIME FOR COMPANY DRILL	ARTEP															
	VEHICLE FIRING PROFICIENCY				DELIBERATE ATTACK LIVE FIRE				DEFEND AGAINST AIRCRAFT				DEFENSE LIVE FIRE			
	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD
MOVE PLT/SQD	---	---	---	.8	---	.4	.6	---	---	---	.2	---	---	---	.4	---
Co.	---	---	---	.3	---	.3	.2	---	---	---	.1	---	---	---	.1	---
SHOOT PLT/SQD	---	---	---	.8	---	.4	.8	---	---	---	.4	---	---	---	.8	---
Co.	---	---	---	.4	---	.4	.4	---	---	---	.2	---	---	---	.5	---
COMMO PLT/SQD	---	---	---	.4	---	.3	.4	---	---	---	.2	---	---	---	.3	---
Co.	---	---	---	.3	---	.3	.2	---	---	---	.1	---	---	---	.2	---
FIRE MANEUVER PLT/SQD	---	---	---	.8	---	1.2	1.2	---	---	---	.8	---	---	---	1.2	---
Co.	---	---	---	.7	---	.8	1.0	---	---	---	.6	---	---	---	.8	---
RCN SECURITY PLT/SQD	---	---	---	.4	---	.4	.4	---	---	---	.4	---	---	---	.4	---
Co.	---	---	---	.2	---	.4	.3	---	---	---	.3	---	---	---	.3	---
BATTLE PSN PLT/SQD	---	---	---	.1	---	---	---	---	---	---	---	---	---	---	2.0	---
Co.	---	---	---	.1	---	---	---	---	---	---	---	---	---	---	1.0	---
SQD ATK PLT/SQD	---	---	---	.1	---	.2	.2	---	---	---	.1	---	---	---	.2	---
Co.	---	---	---	.1	---	.3	.1	---	---	---	.1	---	---	---	.1	---
SQD	---	---	---	.1	.1	.3	.2	---	---	---	.1	---	---	---	.3	---
Co.	---	---	---	.1	.1	.3	.1	---	---	---	.1	---	---	---	.1	---
MOVE	---	---	---	.1	.1	.3	.2	---	---	---	.1	---	---	---	.2	---

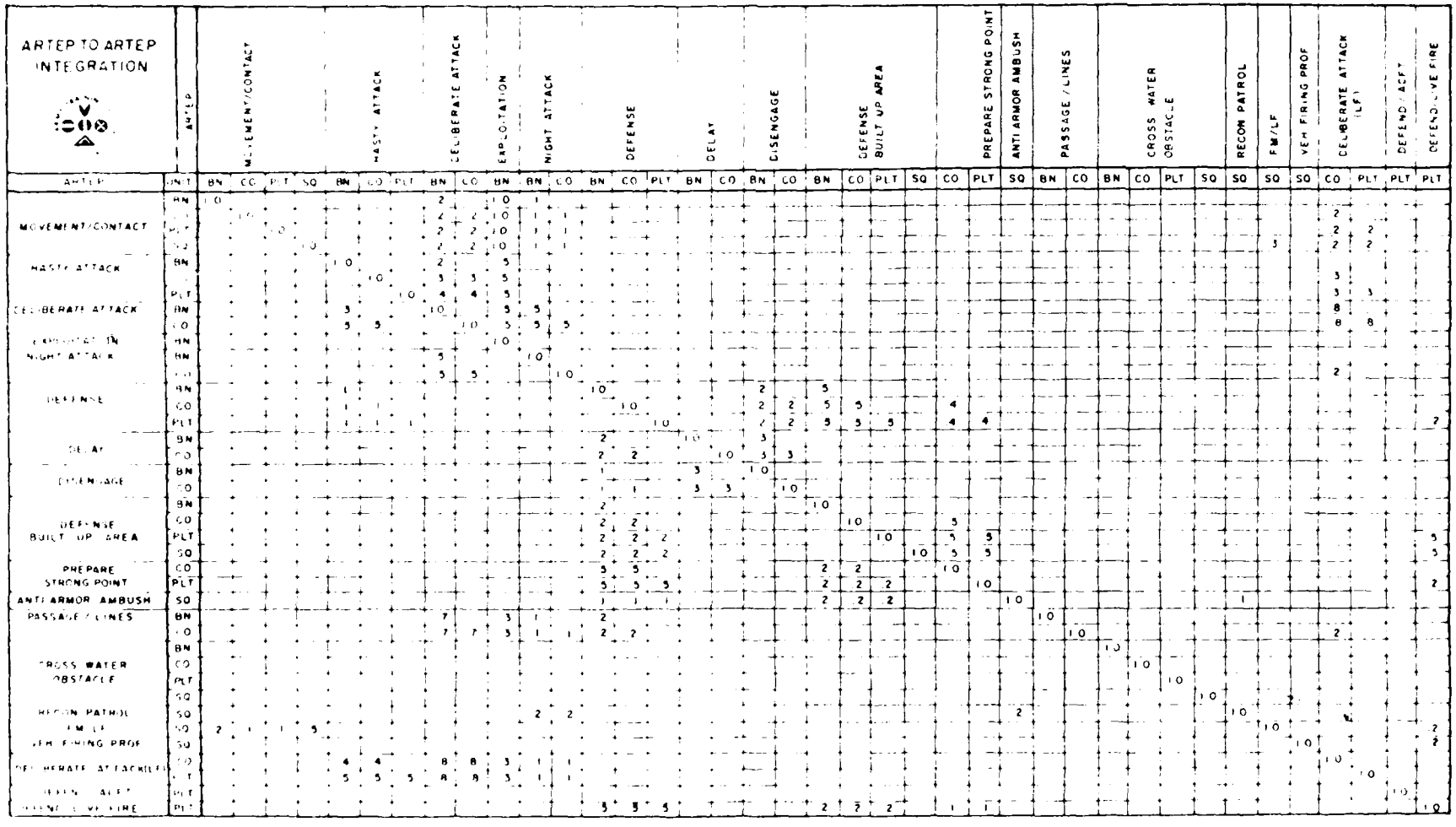
BATTLE DRILL - ARTEP INTEGRATION

SQUAD/PLATOON CREDIT DOUBLED BECAUSE MORE THAN 2 X TIME FOR COMPANY DRILL	ARTEP																			
	ANTIARMOR AMBUSH				PASSAGE LINES				WATER OBSTACLE				PATROLLING				FORCED MARCH LIVE FIRE			
	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD	BN	CO	PLT	SQD
MOVE PLT/SQD	---	---	---	.4	.8	.9	---	---	.2	.4	.6	.6	---	---	---	1.0	---	---	---	1.0
Co.	---	---	---	.1	.6	.8	---	---	.1	.3	.2	.2	---	---	---	.4	---	---	---	.4
SHOOT PLT/SQD	---	---	---	.8	.2	.3	---	---	.1	.1	.1	.1	---	---	---	.4	---	---	---	.8
Co.	---	---	---	.3	.2	.3	---	---	.1	.1	.1	.1	---	---	---	.2	---	---	---	.4
COMMO PLT/SQD	---	---	---	.4	.3	.3	---	---	.2	.2	.3	.3	---	---	---	.4	---	---	---	.4
Co.	---	---	---	.3	.3	.4	---	---	.3	.3	.2	.2	---	---	---	.3	---	---	---	.2
FIRE MANEUVER PLT/SQD	---	---	---	.3	.4	.5	---	---	.3	.3	.4	.5	---	---	---	.4	---	---	---	1.2
Co.	---	---	---	.2	.4	.5	---	---	.3	.4	.3	.3	---	---	---	.3	---	---	---	1.0
RCN SECURITY PLT/SQD	---	---	---	.8	.4	.4	---	---	.2	.2	.4	.4	---	---	---	.8	---	---	---	.4
Co.	---	---	---	.4	.3	.3	---	---	.2	.3	.3	.2	---	---	---	.4	---	---	---	.3
BATTLE PSN PLT/SQD	---	---	---	.8	.4	.4	---	---	.1	.1	.1	.1	---	---	---	.2	---	---	---	.4
Co.	---	---	---	.6	.2	.2	---	---	.1	.1	.1	.1	---	---	---	.1	---	---	---	.2
SUSTAIN PLT/SQD	---	---	---	.1	.1	.1	---	---	.1	.1	.1	.1	---	---	---	.1	---	---	---	.1
Co.	---	---	---	.1	.1	.1	---	---	.1	.1	.1	.1	---	---	---	.1	---	---	---	.1
SPT Co.	---	---	---	.1	.1	.1	---	---	.2	.2	.1	.1	---	---	---	.1	---	---	---	.1
NBC Co.	---	---	---	.1	.1	.1	---	---	---	.1	.1	.1	---	---	---	.1	---	---	---	.1
MOUT Co.	---	---	---	.1	.1	.1	---	---	.1	---	---	.1	---	---	---	.2	---	---	---	.1

BATTLE DRILL

BATTLE DRILL- ARTEP INTEGRATION

ANNEX H


ARTEP TO ARTEP INTEGRATION
ARTEP
UNIT
MOVEMENT/CONTACT
HASTY ATTACK
DELIBERATE ATTACK
EXPLOITATION
NIGHT ATTACK
DEFENSE
DELAY
DISENGAGE
DEFENSE BUILT UP AREA
PREPARE STRONG POINT
ANTI ARMOR AMBUSH
PASSAGE / LINES
CROSS WATER OBSTACLE
RECON PATROL
FM/LF
VEH FIRING PROF
DELIBERATE ATTACK (LF)
DEFEND / ACFT
DEFENSIVE FIRE
BN
CO
PLT
SQ



ANNEX I

					MOVE	SHOOT	FIRE & MANEUVER	RECON & SECURITY	COMMUNICATE	BATTLE POSI	TION/HOLD	SUSTAIN	SUPPORT	NBC	MOUT
DURING A BATTALION MOVEMENT TO CONTACT A UNIT RECEIVES CREDIT FOR .5, .1, AND .3 FREQUENCIES OF THE MOVE, FIRE, AND MANEUVER, AND RECONNASISSANCE DRILLS RESPECTIVELY.		HRS	FREQ	PROD	UNIT											
1.	Movement to contact	6	4	24	BN	.5	.1	.1	.3	.5	.1	.2	.3	.1	.1
		6	6	36	CO	.5	.1	.1	.3	.5	.1	.2	.3	.1	.1
		6	6	36	PLT	.5	.1	.1	.3	.5	.1	.2	.3	.1	.1
		3	6	18	SQD	.5	.1	.1	.3	.5	.1	.2	.3	.1	.1
2.	Hasty attack	6	3	18	BN	.2	.5	.5	.2	.1	.1	.1	.2	.1	.1
		6	5	30	CO	.2	.5	.5	.2	.1	.1	.1	.2	.1	.1
		5	6	30	PLT	.2	.5	.5	.2	.1	.1	.1	.2	.1	.1
3.	Deliberate attack	7	4	28	BN	.3	.5	.5	.3	.1	.1	.2	.3	.1	.1
		7	5	35	CO	.3	.5	.5	.3	.1	.1	.2	.3	.1	.1
4.	Exploitation	7	2	14	BN	.5	.3	.3	.3	.1	.1	.2	.2	.1	.1
5.	Night attack	10	4	40	BN	.1	.2	.25	.1	.2	.1	.1	.2	.1	0
		8	5	40	CO	.1	.2	.25	.1	.2	.1	.1	.2	.1	0
6.	Defense	14	4	56	BN	.1	.3	.1	.5	.1	.7	.4	.4	.1	.2
		13	5	65	CO	.1	.3	.1	.5	.1	.7	.4	.4	.1	.2
		12	6	72	PLT	.1	.3	.1	.5	.1	.7	.4	.4	.1	.2
7.	Delay	10	3	30	BN	.4	.2	.2	.3	.4	.4	.3	.3	.1	.1
		8	6	48	CO	.4	.2	.2	.3	.4	.4	.3	.3	.1	.1
8.	Disengage (under pressure)	8	4	32	BN	.4	.3	.5	.3	.2	.1	.1	.3	.3	.2
		6	5	30	CO	.4	.3	.5	.3	.2	.1	.1	.3	.3	.2

ARTEP - BATTLE DRILL INTEGRATION

	HRS	FREQ	PROD	UNIT	MOVE	SHOOT	FIRE & MANEUVER	RECON & SECURITY	COMMUNICATE	BATTLE POSI	TION/HOLD	SUSTAIN	SUPPORT	NBC	MOUT
9. Defense of a built-up area	6	2	12	BN	.1	.2	.2	.1	.1	.5		.1	.2	.1	.7
	6	3	18	CO	.1	.2	.2	.1	.1	.5		.1	.2	.1	.7
	5	3	15	PLT	.1	.2	.2	.1	.1	.5		.1	.2	.1	.7
	5	3	15	SQD	.1	.2	.2	.1	.1	.5		.1	.2	.1	.7
10. Prepare a strong point	10	4	40	CO	0	.1	.1	.3	.1	.5		.2	.3	.1	.3
	6	4	24	PLT	0	.1	.1	.3	.1	.5		.2	.3	.1	.3
11. Antiarmor ambush	4	6	24	SQD	.1	.5	.3	.4	.1	.3		.1	.3	.2	.5
12. Passage of lines	6	3	18	BN	.5	.1	.1	.3	.5	0		0	.3	0	.1
	4	5	20	CO	.5	.1	.1	.3	.5	0		0	.3	0	.1
13. Crossing water obstacles (river crossing)	7	3	21	BN	.2	.1	.4	.3	.2	.1		.1	.3	.2	0
	5	3	15	CO	.2	.1	.4	.3	.2	.1		.1	.3	.2	0
	4	3	12	PLT	.2	.1	.4	.3	.2	.1		.1	.3	.2	0
	3	3	9	SQD	.2	.1	.4	.3	.2	.1		.1	.3	.2	0
14. Patrolling (reconnaissance and combat)	5	6	30	SQD	.4	.2	.2	.7	.3	.1		.1	.2	0	0
15. Forced March/ Live Fire	3	6	18	SQD	.4	.4	.2	.1	.1	.2		0	0	0	0
16. Vehicle Firing Proficiency	3	4	12	SQD	.1	.3	.3	.1	.1	.1		.1	.1	.1	0

ARTEP - BATTLE DRILL INTEGRATION

	HRS	FREQ	PROD	UNIT	MOVE	SHOOT	FIRE & MANEUVER	RECON & SECURITY	COMMUNICATE	BATTLE POSI TION/HOLD	SUSTAIN	SUPPORT	NBC	MOUT
17. Deliberate Attack (Live Fire)	8 4	4 4	32 16	CO PLT	.1 .1	.4 .4	.5 .5	.3 .3	.2 .2	.1 .1	.2 .2	.2 .2	.1 .1	0 0
18. Defend against Attack (Live Fire)	4	6	24	PLT	0	.3	0	0	.1	0	0	0	0	0
19. Defense (Live Fire)	8	4	32	PLT	.1	.3	.1	.2	.2	.7	.2	.3	.1	0

ARTEP-BATTLE DRILL INTEGRATION



ANNEX J

BATTLE DRILL RESULTS

Personnel Conditions

	SET I	SET II
Turbulence %/Qtr	35	20
Not Present for Tng %/Day	25	20
Fill-Officer/NCO	85	85

Time Durations and Frequencies

	SET I		SET II	
ARTEP/BATTLE DRILLS	Time (Hr)	Frequency	Time (Hr)	Frequency
Move (Company)	7	1/Yr	7	1/Yr
Move (Plt & Sqd)	22	4/Yr	22	4/Yr
Shoot (Company)	5	4/Yr	5	3/Yr
Shoot (Plt & Sqd)	41	4/Yr	41	3/Yr
Fire/Maneuver (Co)	21	4/Yr	21	3/Yr
Fire/Maneuver (Plt & Sqd)	49	6/Yr	49	4/Yr
Recon/Security (Co)	16	5/Yr	16	3/Yr
Recon/Security (Plt & Sqd)	59	3/Yr	59	2/Yr
Commo (Company)	6	4/Yr	6	3/Yr
Commo (Plt & Sqd)	15	3/Yr	15	2/Yr
Battle Position (Co)	14	4/Yr	14	3/Yr
Battle Position (Plt & Sqd)	37	4/Yr	37	3/Yr
Sustain (Company)	12	6/Yr	12	3/Yr
Sustain (Plt & Sqd)	42	4/Yr	42	3/Yr
Support (Company)	56	5/Yr	56	3/Yr
NBC	19	5/Yr	19	3/Yr
MOUT	16	3/Yr	16	2/Yr

ANNEX K

ARTEP EXPANSION

APPENDIX II TO CHAPTER 8 OF ARTEP 71-2

TRAINING AND EVALUATION OUTLINE

UNIT: COMPANY TEAM

MISSION: HASTY ATTACK

1. GENERAL CONDITIONS

The team has made contact with the opposing force and the initial situation has developed that indicates the opposing force can be defeated by the team conducting a hasty attack. The opposing force equipment includes BMP personnel carriers, T62 tanks, track-mounted and suitcase Saggers, RPG7's, and BRDM scout vehicles. Air parity exists.

The company team may be continuing a tactical mission (e.g., movement to contact or deliberate attack). The company team commander will be given orders and will issue frag orders to team elements.

2. PRIMARY TRAINING/EVALUATION STANDARDS

To receive a satisfactory rating, the company team must conduct the hasty attack using fire and maneuver while not suffering excessive casualties and equipment loss. (Evaluator judgment.)

3. TRAINING/EVALUATION RESULTS

Check SAT or UNSAT on the following pages of this T&EO to indicate the unit's proficiency on each task for this mission. Trainers/evaluators will record, on an attached sheet of paper, or in the space provided, detailed observations of training deficiencies which need training emphasis. This T&EO and attached sheets should be provided to the unit as a basis for future training. The overfall proficiency rating for this mission is determined from the performance of the unit on each task, the primary training and evaluations standards, and the evaluator/trainer's subjective judgment as to whether the unit would have been successful on the modern battlefield had it performed as it did in this exercise. Circle one of the following to indicate the overall combat proficiency of the unit on this mission:

Overall Proficiency: SAT UNSAT

4. TRAINING/EVALUATION GUIDE - Hasty Attack

In accomplishing the mission, the company team should have demonstrated proficiency in the following battle drills incorporating individual and collective tasks. For discussion of ways to achieve integrated, multiechelon training, see TC 21-5-7.

Battle Drill/ Training Drill	Collective Task	Individual Tasks
Fire and Maneuver	Cover & Conceal	Select temporary battlefield positions
	Employ fire and maneuver/movement	Move as a member of a fire team
	Employ fighting vehicles	React to indirect fire
	Breach minefields & obstacles	Move over, through and and around obstacles
	Reorganize & consolidate	. . . . .
Move	Tactical movements	. . . . .
	Cover & Conceal	. . . . .
Shoot	Employ organic AT weapons	. . . . .
	Employ fighting vehicles	. . . . .
	Employ organic small arms	. . . . .
Support	Coordinate employment of nonorganic combat support assets	. . . . .
	Breach minefields & obstacles	. . . . .
Communicate	Leader/Commander tasks	. . . . .
	Employ communications/CE	. . . . .

Commander's Manual

11B/11C INFANTRYMAN



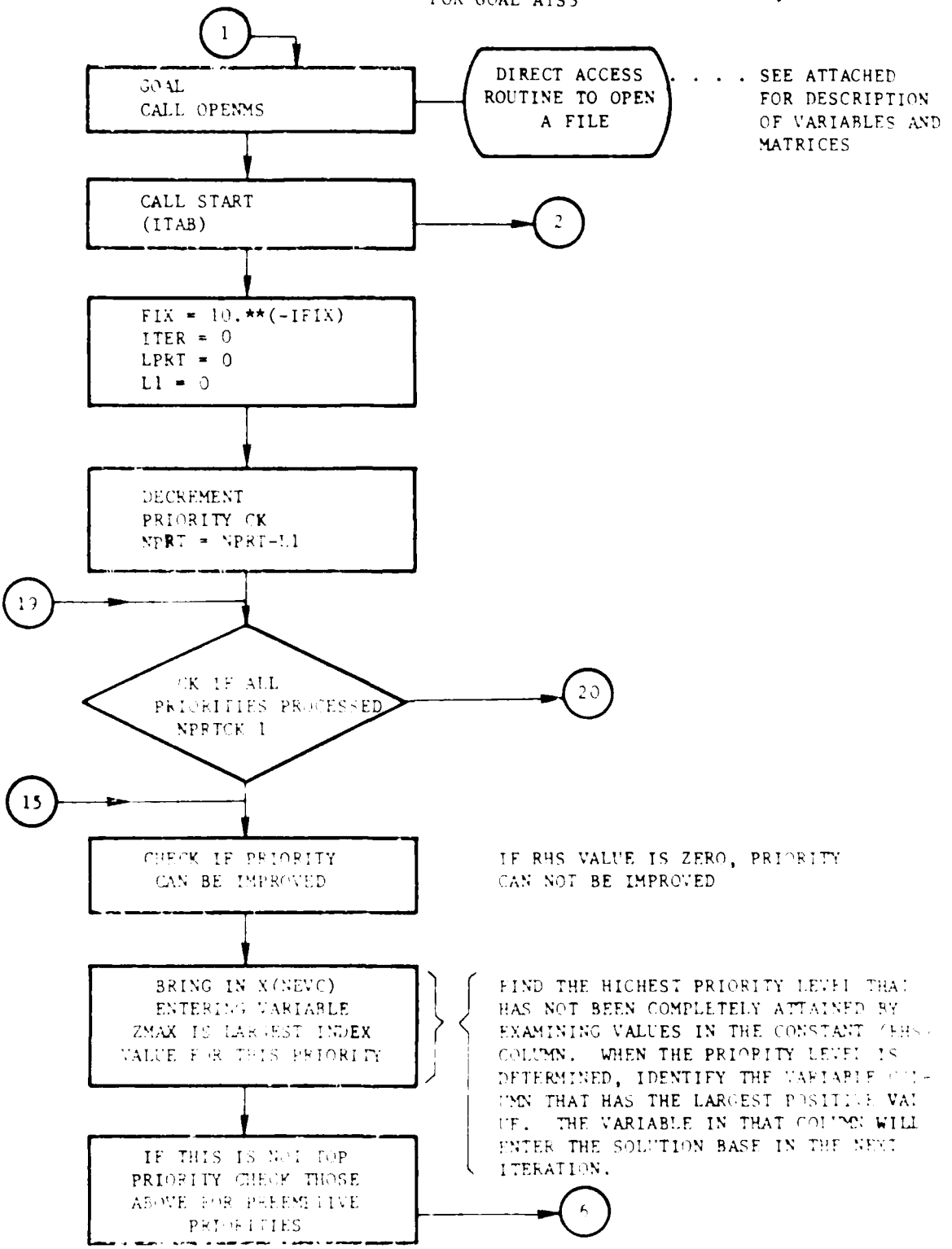
COMMANDER'S MANUAL
11B and 11C
INFANTRYMAN

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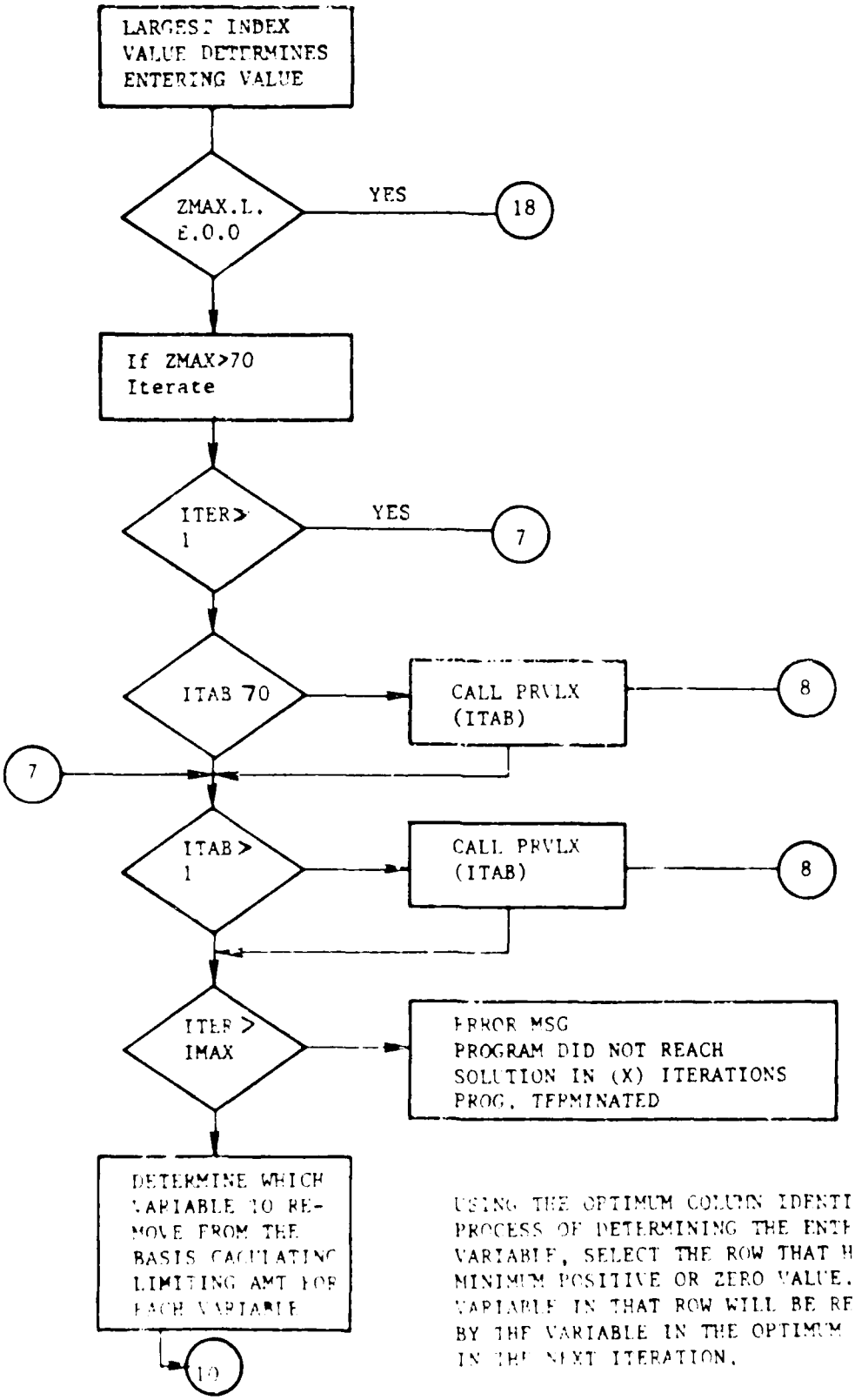
ANNEX M

SYSTEM PROGRAMMIMG FLOW CHART

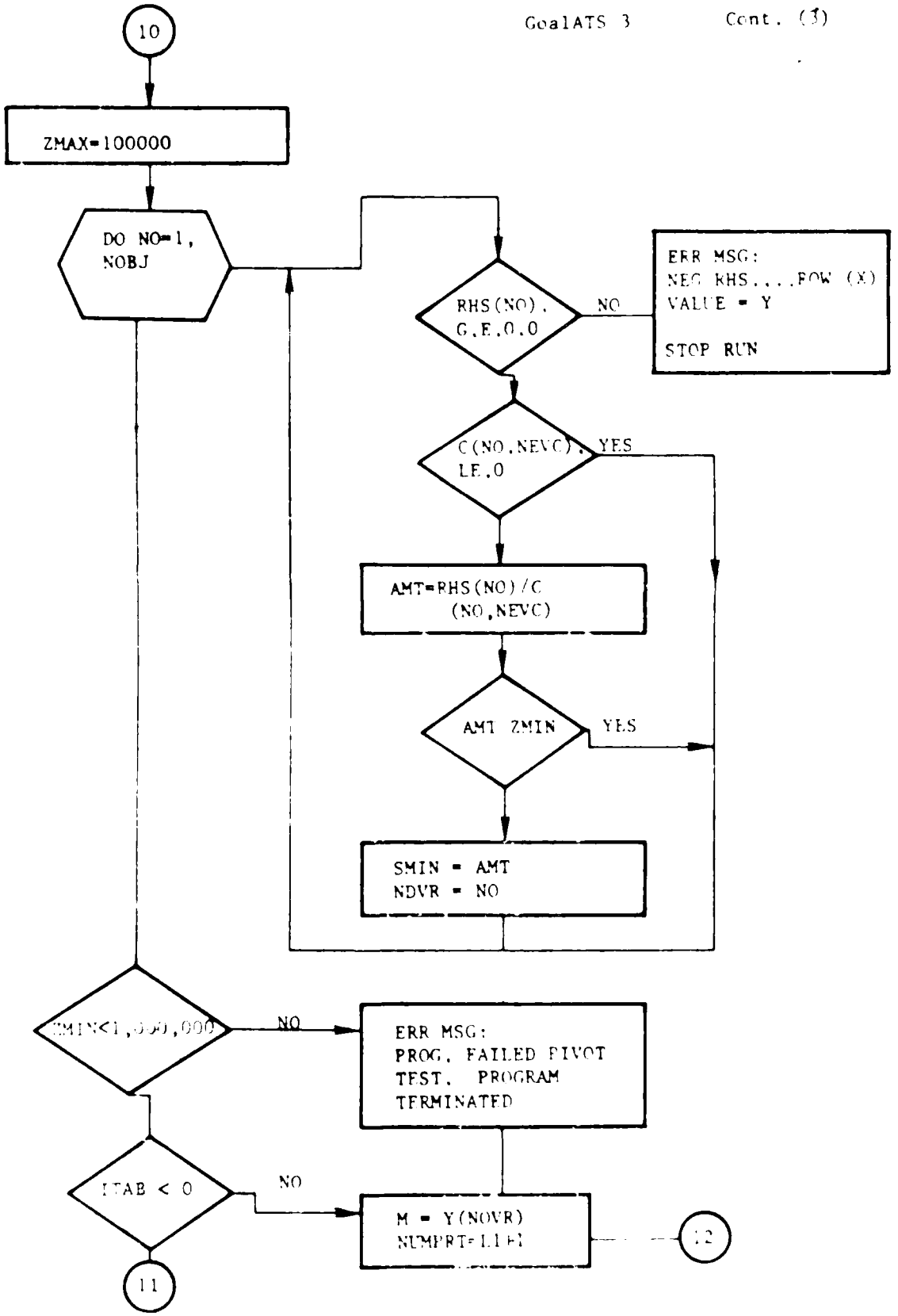
FOR GOAL ATS3



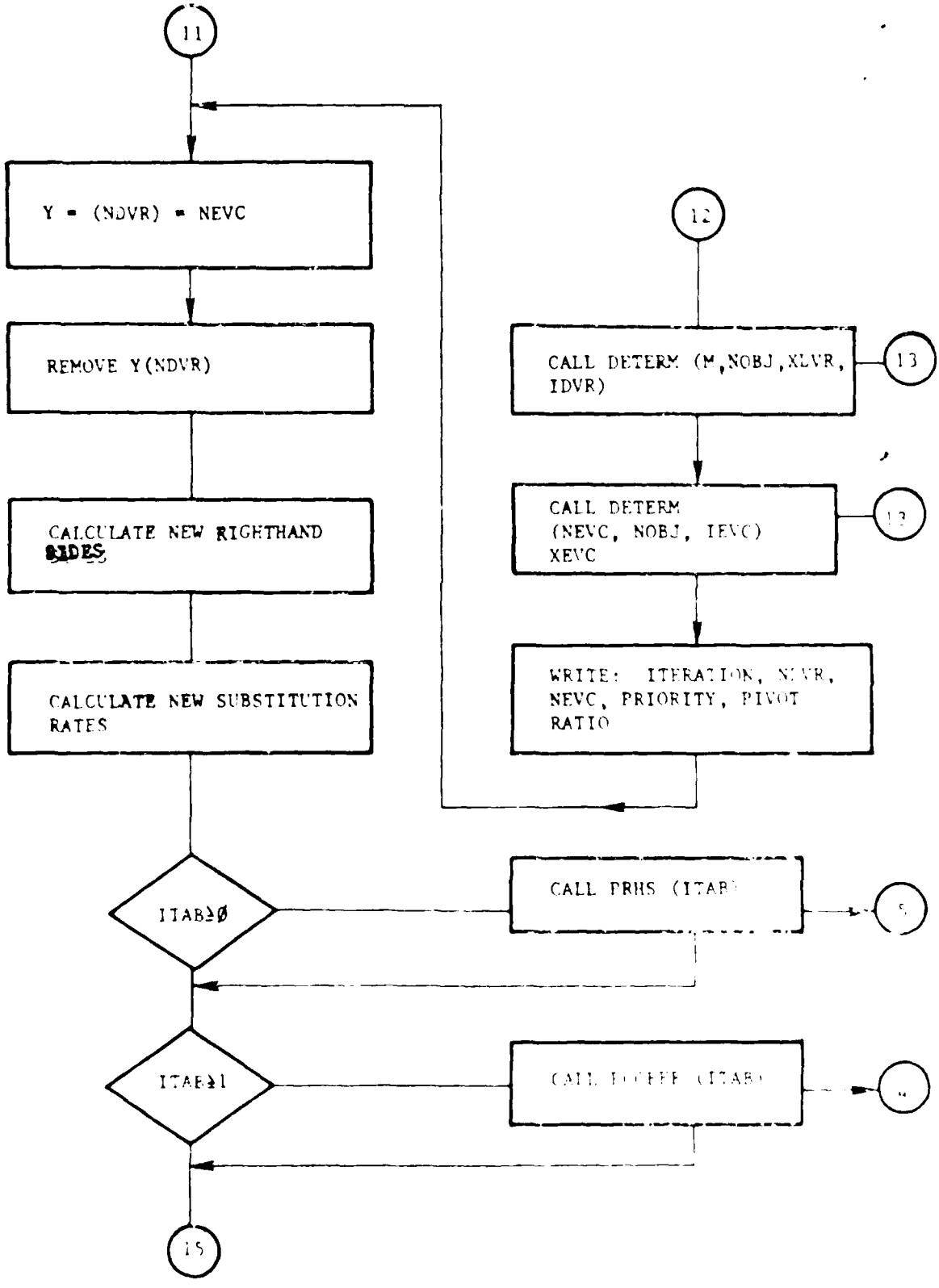
CoalATS Cont. (2)

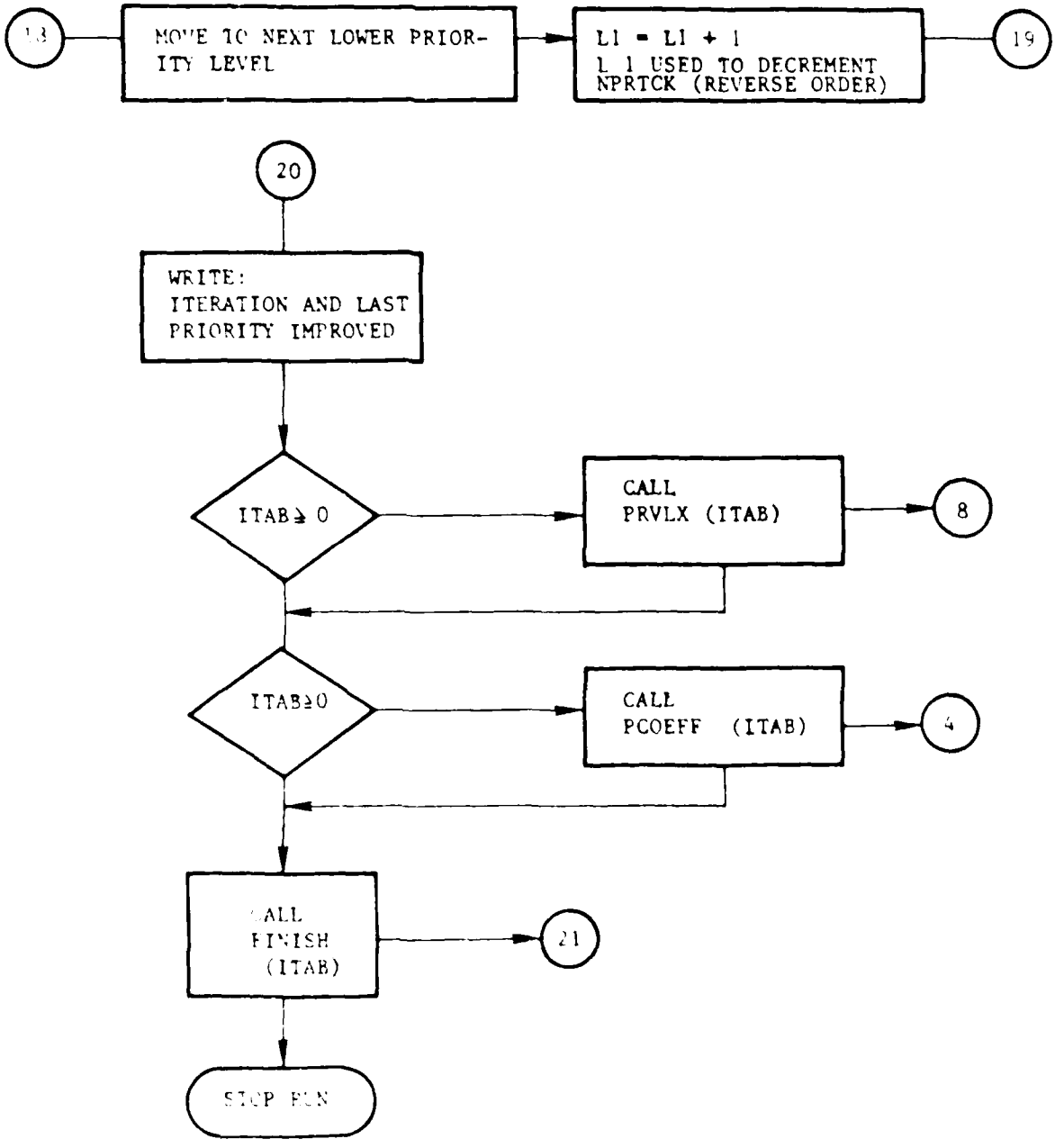


USING THE OPTIMUM COLUMN IDENTIFY IN PROCESS OF DETERMINING THE ENTERING VARIABLE, SELECT THE ROW THAT HAS THE MINIMUM POSITIVE OR ZERO VALUE. THE VARIABLE IN THAT ROW WILL BE REPLACED BY THE VARIABLE IN THE OPTIMUM COLUMN IN THE NEXT ITERATION.


10
ZMAX=100000
DO NO=1, NOBJ
RHS(NO).G.E.0.0
NO
ERR MSG:
NEG RHS....ROW (X)
VALUE = Y
STOP RUN
C(NO,NEVC).LE.0
YES
AMT=RHS(NO)/C (NO,NEVC)
AMT ZMIN
YES
SMIN = AMT
NDVR = NO
ZMIN<1,000,000
NO
ERR MSG:
PROG. FAILED PIVOT TEST. PROGRAM TERMINATED
ITAB < 0
NO
M = Y(NOVR)
NUMPRT=LIFT
12
11

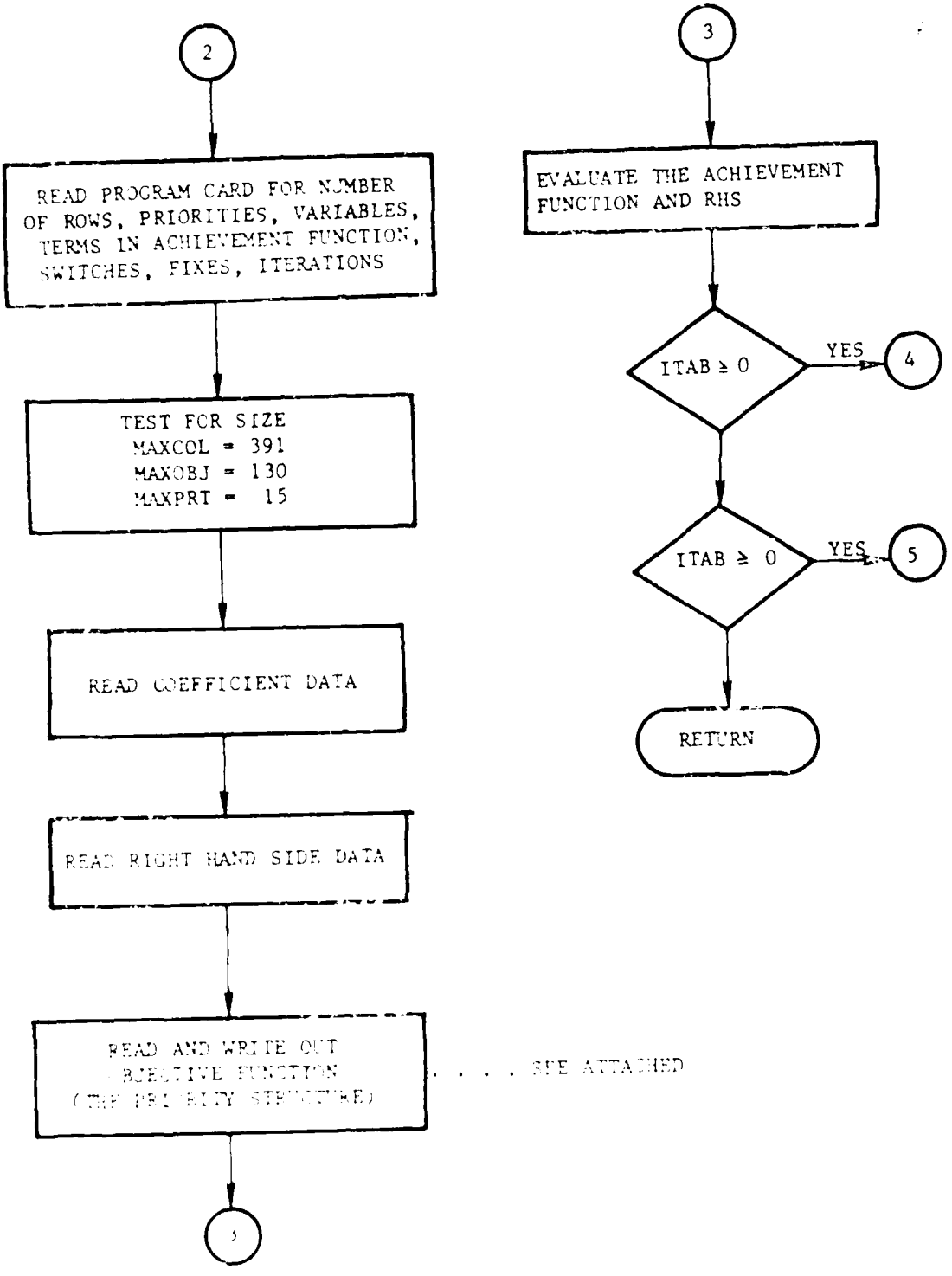
Cont. (4)


11
Y = (NDVR) = NEVC
REMOVE Y(NDVR)
CALCULATE NEW RIGHTHAND SIDES
CALCULATE NEW SUBSTITUTION RATES
ITAB≥Ø
ITAB≥1
15
12
CALL DETERM (M,NOBJ,XLVR, IDVR)
13
CALL DETERM (NEVC, NOBJ, IEVC) XEVC
WRITE: ITERATION, NDVR, NEVC, PRIORITY, PIVOT RATIO
CALL PRHS (ITAB)

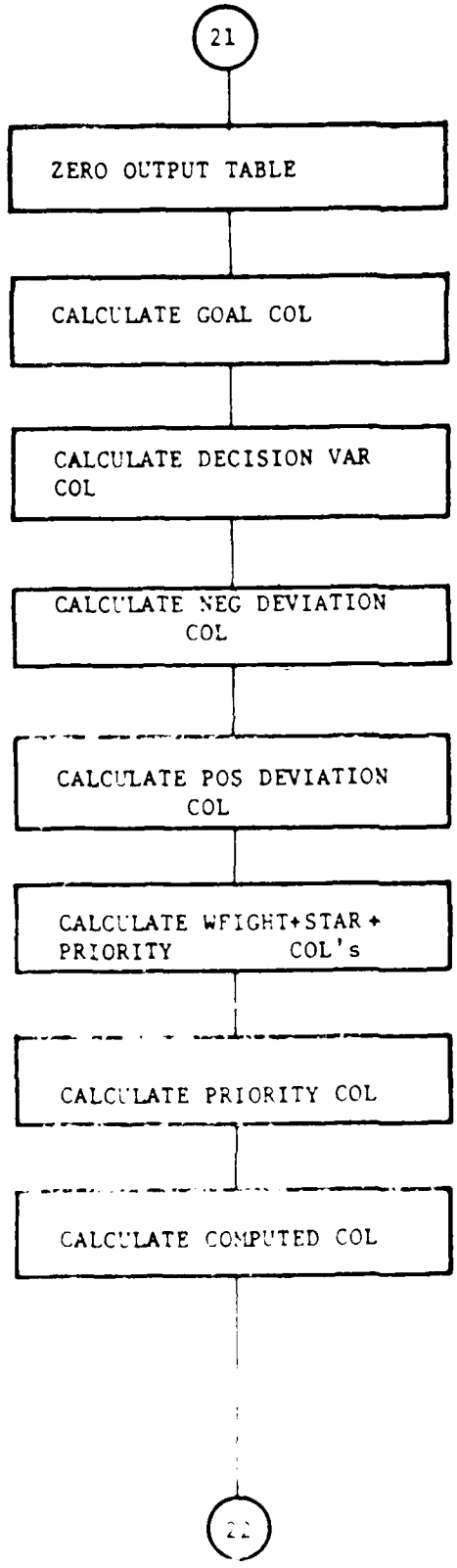

13
MOVE TO NEXT LOWER PRIOR-
ITY LEVEL
L1 = L1 + 1
L 1 USED TO DECREMENT
NPRTCK (REVERSE ORDER)
19
20
WRITE:
ITERATION AND LAST
PRIORITY IMPROVED
ITAB ≥ 0
CALL
PRVLX (ITAB)
8
ITAB≥0
CALL
PCOEFF (ITAB)
4
CALL
FINISH
(ITAB)
21
STOP RUN

START SUBROUTINE

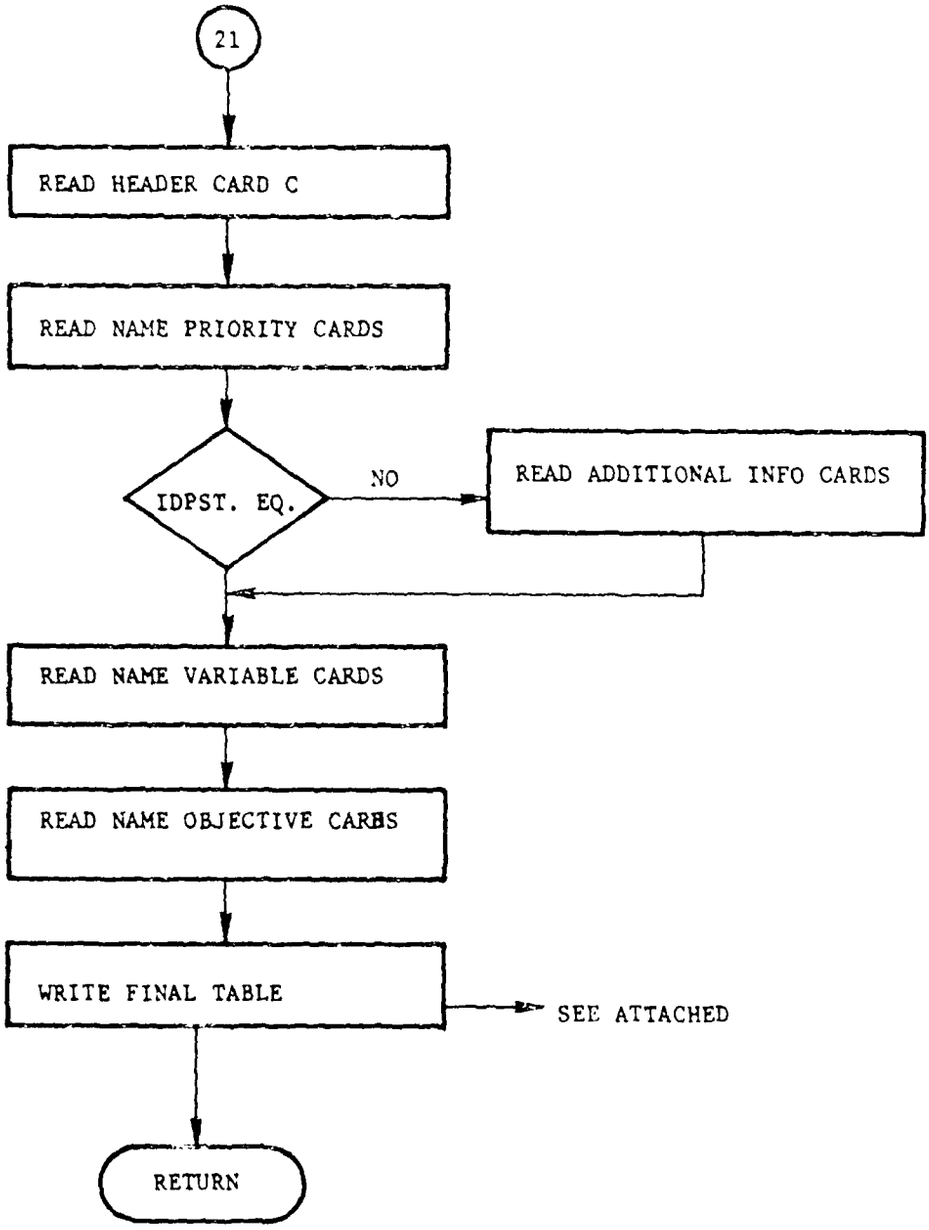
PURPOSE: PROCESSES THE PROBLEM PARMATERS; LOADS INITIAL MATRICES



. . . . SEE ATTACHED

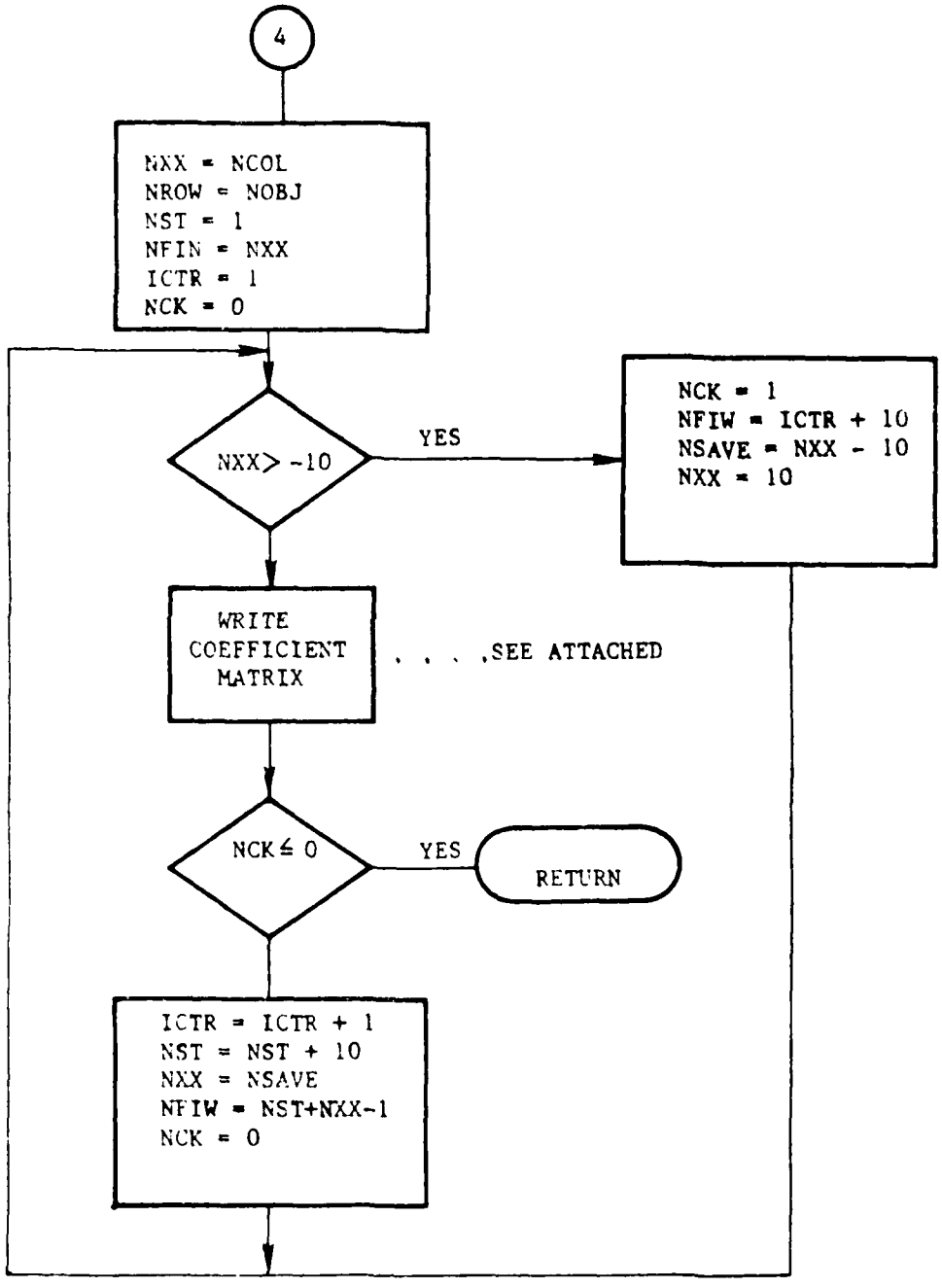


PURPOSE: PREPARES PRINTOUT OF DEVIATION ANALYSIS.

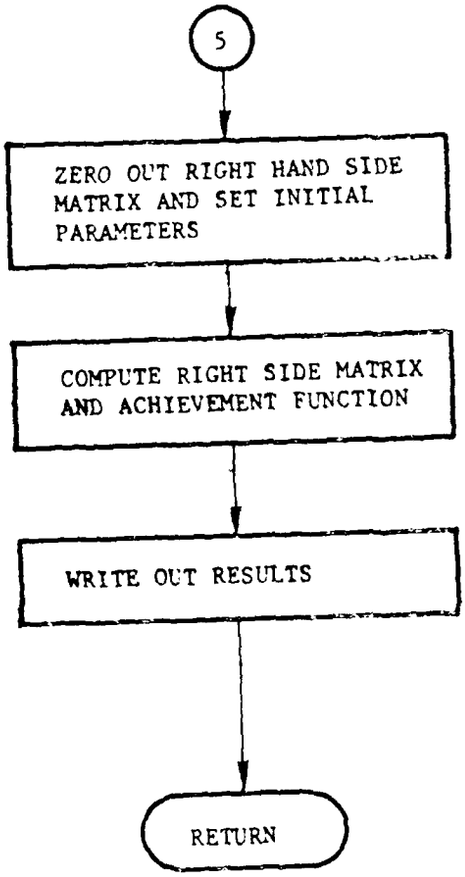

21
READ HEADER CARD C
READ NAME PRIORITY CARDS
IDPST. EQ.
NO
READ ADDITIONAL INFO CARDS
READ NAME VARIABLE CARDS
READ NAME OBJECTIVE CARDS
WRITE FINAL TABLE
SEE ATTACHED
RETURN

PCOEFF SUBROUTINE

PURPOSE: PRINTS THE COEFFICIENT MATRIX.



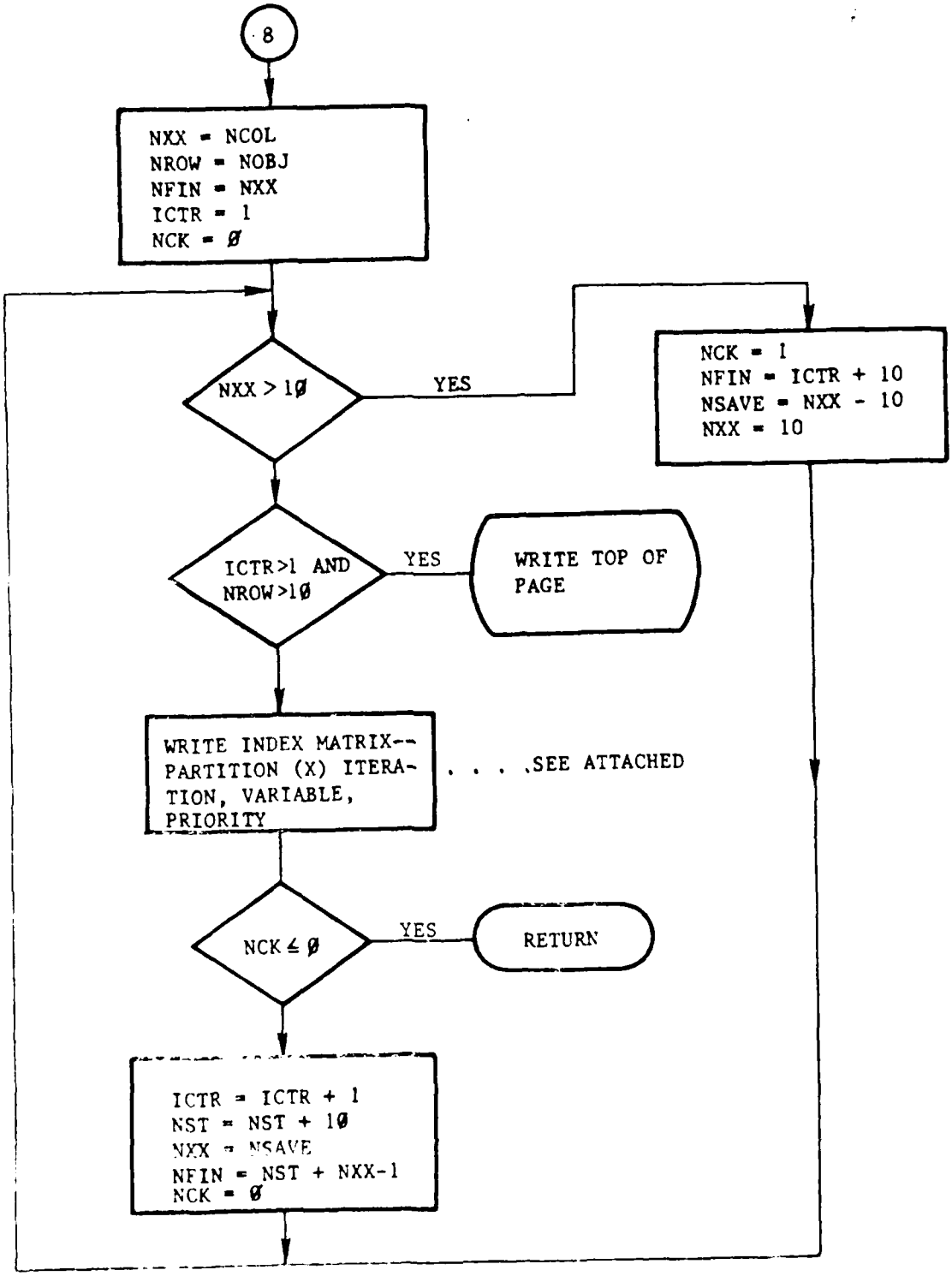
FRHS SUBROUTINE

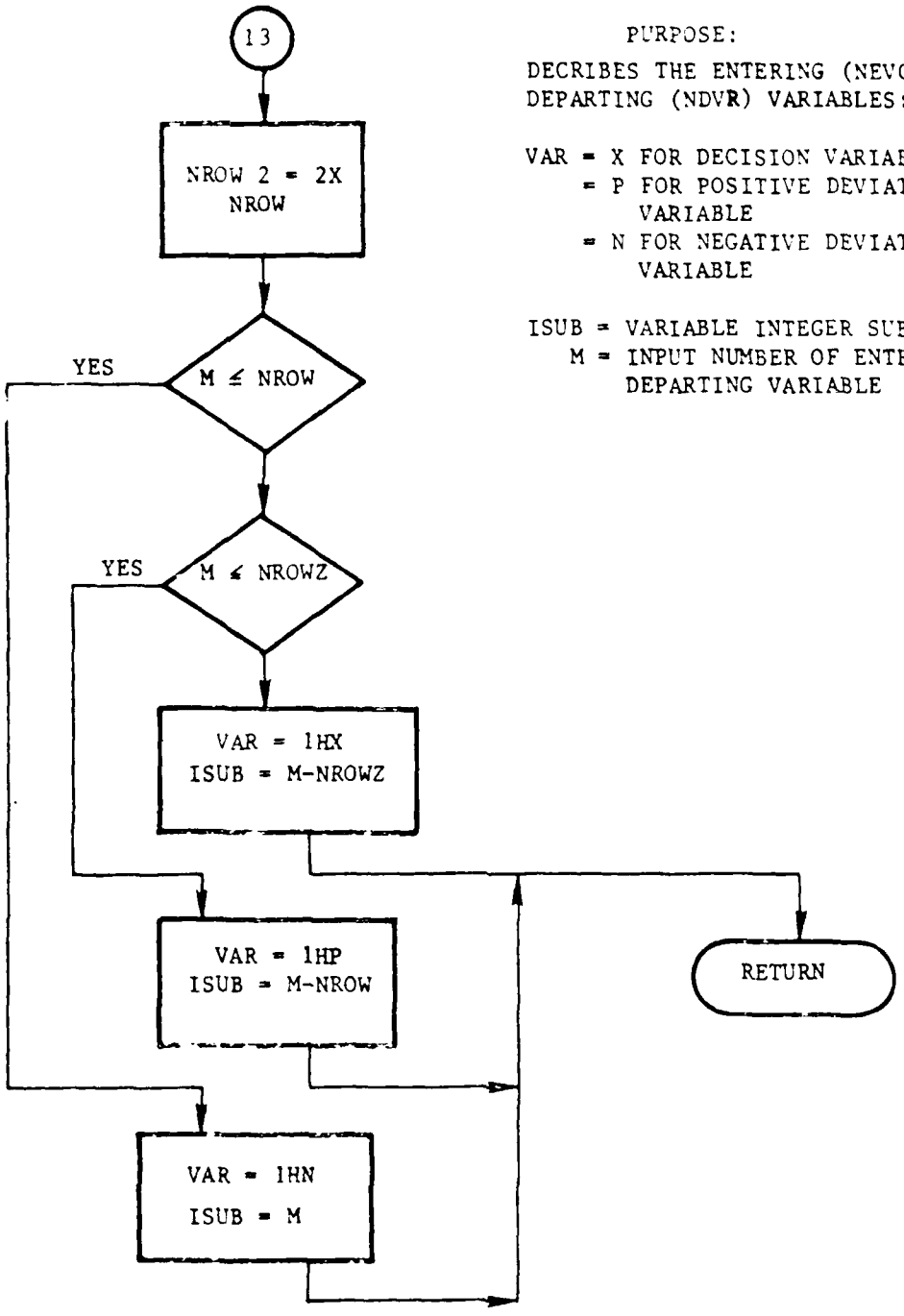


PURPOSE: PRINTS THE RIGHT HAND SIDE VALUES, AND ACHIEVEMENT FUNCTION.

PRVLX SUBROUTINE

PURPOSE: PRINTS THE INDEX MATRIX.





PURPOSE:

DECRIBES THE ENTERING (NEVC) AND DEPARTING (NDVR) VARIABLES:

VAR = X FOR DECISION VARIABLE
= P FOR POSITIVE DEVIATION VARIABLE
= N FOR NEGATIVE DEVIATION VARIABLE

ISUB = VARIABLE INTEGER SUBSCRIPT
M = INPUT NUMBER OF ENTERING OR DEPARTING VARIABLE

DESCRIPTION OF VARIABLES AND MATRICES

Dimensions in common allow 130 OBJ, 15 PRI, 130 VAR

MATRICES

C -- Coefficient Matrix
D -- Stored Coefficient Matrix
HEADER -- Header
IIPRI -- List of priorities associated with each objective
NAMOBJ -- Name of Objectives
NAMPRI -- Name of Priorities
NAMVAR -- Names of Variables
RHS -- Present Value of Basic Variables
RHS1 -- Saved Value of Original Goals
RVLX -- The Index Matrix, Bottom Stub, TI
SCENAR -- Scenario Header
STAR -- Matrix to Mark Which Deviation Variable is Being Minimized
VALX -- The Top Stub, TT
VALY -- The Left Stub, TL
WOUT -- The Write-Out Matrix (In Finish and Summary)
X -- The Vector of all Variables
Both Decision and Deviation Variables
Both Basic and Non-Basic Variables
Y -- The Vector of Basic Variables
ZVAL -- The Achievement Values

SCALARS

IDIAG -- Use for Diagnostics Write-Out (Not in this Version)
IFIX -- Fix = 10.** (-IFIX), IFIX = -LOG(FIX); It is used to Compensate for Extremely Small Non-Integer Answers When Zero Would be Correct
IMAX -- Maximum Number of Iterations
ITAB -- Table Printout Switch
L1 -- Used to Decrement Priority Being Checked (NPRICK) Due to Inverted Order Used in Computations
MAXCOL -- Maximum ; of Columns
MAXOBJ -- Maximum ; of Objectives
MAXPRT -- Maximum ; of Priorities
NCOL -- Number of Columns in Coefficient Matrix = NVAR + 2 * NOBJ
NDVR -- Number of Departing Variable Row
NEVC -- Number of Entering Variable Column
NOBJ -- Number of Objectives (Or Rows)

```
NPCKP1 = NPRTCK + 1 -- Used to Increment Being Checked
NPRT -- Number of Priorities in the Achievement Function
NPRTCK -- Number of Priority Being Checked
NROWS -- Number of Objectives (Or Rows)
NTAF -- Number of Terms in the Achievement Function
NVAR -- Number of Decision Variables
SUMP -- Used to Compute New Index Values
ZMAX -- Largest Index Value for Current Priority Being Checked
ZMIN -- Limiting Amount for Each Entering Variable, the Minimum
        Ratio

Loops are Incremented as Follows
  NC -- The NC-TH Column
  NO -- The NO-TH Objective
  NP -- The NP-TH Priority
  NR -- The NR-TH Row
  NT -- The NT-TH Term in the Achievement Function
  NV -- The NV-TH Variable

ITAB is Used to Selectively Print out Tables
  -1 -- None
   0 -- First and Last Coefficient and Index Matrices
   1 -- Also RHS
   2 -- All
```

ANNEX N

BASELINE COMPUTER PROGRAM

This is the FORTRAN program that was originally developed by Concepts Analysis Agency and modified by the ARTS Study Group for purposes of developing the Battalion Training Model (BTM). The program is modular in design and is amply described by use of comment cards throughout the entire program. The program is operating on a CDC 6600 computer.

```
      PROGRAM GOAL(INPUT=65,OUTPUT=65,TAPE5=INPUT,
     1     TAPE6=OUTPUT,TAPE7=10001B,TAPE3=10013)
C  GOAL PROGRAMMING   (LEE)   =2GP2LPE-PROG      3 JAN 78
C          GOAL PROGRAMMING   REF. GP FOR DECISION ANALYSIS  SANG LEE
           DIMENSION D(130),I(391)
      COMMON C(130,390),
     1     OFUN(3,260),RHS(130),RHS1(130),
     2     RVLX(15,390),SAVEC(130,130),
     3     VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     4     X2VEC(390),ZVAL(15),IFIX,IMAX,ITER,NCOL,NOBJ,
     5       NPRT,NTAF,NVAR,IDSPT
      INTEGER X2VEC

C     DIMENSIONS IN COMMON ALLOW 130 OBJ, 15 PRI, 130 VAR

C           MATRICES

C
C       C  --  COEFFICIENT MATRIX
C       D  --  STORED COEFFICIENT MATRIX
C       HEADER  --   HEADER
C       IIPRI -- LIST OF PRIORITIES ASSOCIATED WITH EACH OBJECTIVE
C       NAMOBJ  --  NAME OF OBJECTIVES
C       NAMPRI  --  NAME OF PRIORITIES
C       NAMVAR  --  NAMES OF VARIABLES
C       RHS  -- PRESENT VALUE OF BASIC VARIABLES
C       RHS1 -- SAVED VALUE OF ORIGINAL GOALS
C       RVLX -- THE INDEX MATRIX, BOTTOM STUB, TI
C       SCENAR  --  SCENARIO HEADER
C       STAT  --  MATRIX TO MARK WHICH DEVIATION VARIABLE IS BEING
C                 MINIMIZED
C       VALX -- THE TOP STUB, TT
C       VALY -- THE LEFT STUB ,TL
C       WOUT -- THE WRITE-OUT MATRIX   (IN FINISH AND SUMMARY)
C       X  -- THE VECTOR OF ALL VARIABLES
C             (OTH DECISION AND DEVIATION VARIABLES
C             BOTH BASIC AND NON-BASIC VARIABLES
C       Y  -- THE VECTOR OF BASIC VARIABLE NUMBERS
C       ZVAL -- THE ACHIEVEMENT VALUES

C                 SCALAR

C       IDISP -- USED FOR TABULATING WRITE OUT (NOT IN THIS VERSION)
C       IFIX -- FIX = 10.**(-IFIX),  I.E. FIX=.01(IFIX=2)
C       IMAX  -- MAXIMUM NUMBER OF ITERATIONS
C       ITER  --  TABLE OF ITERATIONS
C       NCOL -- NUMBER OF ELEMENTS IN ITH ROW OF C (NOT INCLUDING
C               THE INVERSE PART OF THE MATRIX)
C       MAXCOL  --  MAXIMUM NUMBER OF COLUMNS
C       MAXROW  --  MAXIMUM NUMBER OF ROWS
C       MAXVAR  --  MAXIMUM NUMBER OF VARIABLES
C       NOBJ  --  NUMBER OF OBJECTIVES IN THE MATRIX
C
C       NPRT  --  NUMBER OF PRIORITIES
C       NTAF  --  NUMBER OF TABLEAUS
C       NVAR  --  NUMBER OF VARIABLES
C       NROW  --  NUMBER OF ROWS IN THE MATRIX
```

```
C       NPCKP1 = NPRTCK + 1  -- USED TO INCREMENT BEING CHECKED
C       NPRT   -- NUMBER OF PRIORITIES IN THE ACHIEVEMENT FUNCTION
C       NPRTCK --  NUMBER OF PRIORITY BEING CHECKED
C       NROWS --  NUMBER OF OBJECTIVES ( OR ROWS)
C       NTAF --   NUMBER OF TERMS IN THE ACHIEVEMENT FUNCTION
C       NVAR --   NUMBER OF DECISION VARIABLES
C       SUMP --   USED TO COMPUTE NEW INDEX VALUES
C       ZMAX --   LARGEST INDEX VALUE FOR CURRENT PRIORITY BEING CHECKED
C       ZMIN --   LIMITING AMOUNT FOR EACH ENTERING VARIABLE,
C                 THE MINIMUM RATIO
C
C       DOES ARE INCREMENTED AS FOLLOWS
C           NC  -- THE NC-TH COLUMN
C           NO  -- THE NO-TH OBJECTIVE
C           NP  -- THE NP-TH PRIORITY
C           NR  -- THE NR-TH ROW
C           NT  -- THE NT-TH TERM IN THE ACHIEVEMENT FUNCTION
C           NV  -- THE NV-TH VARIABLE
C
C       ITAB IS USED TO SELECTIVELY PRINT OUT TABLES
C                 -1   --  NONE
C                  0   --  FIRST AND LAST COEFFICIENT AND INDEX MATRICES
C                  1   --  ALSO RHS
C                  2   --  ALL
C
C       *******                MAIN PROGRAM          ******
C
        CALL START IE READ IN DATA
C
        CALL OPENMS(3,I,391,0)
C
        CALL START(ITAB)
C
C
        IY=10.**(-IPIX)
        IF(IY.EQ.0)
        IY=0
        1 0
C
C           ENTER NEW VARIABLES INTO BASIS
C
C.....
C
C           DO  NEXT PRIORITY
C
C       DO 400 IP=1,
C
C           IF THIS PRIORITY IS NOT IMPROVED
C
C           DO NO IMPROVE
C
C           DO 400
C
C           DO 410 NV=1,N)
```

```
      IF (ABS(SUMF).LT.FIX) SUMF=0.0
  900 CONTINUE
      RVLX(NP,NC)=SUMF-VLX(NP,NC)
      IF (ABS(RVLX(NP,NC)).LT.FIX) RVLX(NP,NC)=0.0
   90 CONTINUE

         BRING IN X(NEV)     ENTERING VARIABLE


            ZMAX IS THE LARGEST INDEX VALUE FOR THIS PRIORITY

      ZMAX=0.
      DO 1000 NC=1,NCOL
      IF (NPRTCK.GE.NPRT) GO TO 900

       IF  THIS ISN'T THE TOP PRIORITY, THEN CHECK THOSE ABOVE
           IT FOR PREEMPTIVE PRIORITIES

      NPRKP1=NPRTCK+1
        DO 800 NP=NPRKP1,NPRT
        IF (RVLX(NP,NC).LT.0.0) GO TO 1000
  800   CONTINUE
  900 IF (RVLX(NPRTCK,NC).LE.ZMAX) GO TO 1000
      ZMAX=RVLX(NPRTCK,NC)

            LARGEST INDEX VALUE DETERMINES THE ENTERING VALUE

      NEV=NC
 1000 CONTINUE
      IF (ZMAX.LE.0.0) GO TO 2100

              IF ZMAX > 0, ITERATE

      LPRT = L1 + 1
      ITR=ITR+1
      IF(ITER.GT.1) GO TO 1005
      IF(ITAB.GT.0) CALL PRVLX(ITAB)
      GO TO 1010
 1005 IF(ITAB.GT.1) CALL PRVLX(ITAB)
 1010 IF (ITR.GT.IMAX) GO TO 3000


            DETERMINE WHAT P VARIABLE TO REMOVE FROM THE BASIS
            BY CALCULATING LIMITING AMT FOR EACH BASIS VARIABLE

      [illegible]
         [illegible]
       [illegible]

      [illegible]

 1100 [illegible]
      [illegible]
      [illegible]
      [illegible]
```

```
 1200 CONTINUE
      IF (ZMIN.LT.99999999.) GO TO 1300
      WRITE (6,3200)

C
C       THIS IS TO INDICATE IT FAILED PIVOT TEST
C
      GO TO 2900
 1300 IF(ITAB.LT.0) GO TO 1350
      M = Y(NOVR)
      NUMPRT = L1 + 1
      CALL CTERM(M,NOBJ,XOVR,IOVR)
      CALL CTERM(NEVC,NOBJ,XEVC,IEVC)
      DO 1301 J=6,7
      WRITE(J,3300)ITER,XOVR,IOVR,XEVC,IEVC,NUMPRT,C(NOVR,NEVC),ZMIN
 1301 CONTINUE
C
C          REMOVE Y(NOVR)
C
 1350 Y(NOVR)=NEVC
      DO 1400 NP=1,NPRT
      VALY(NOVR,NP)=VALX(NP,NEVC)
      ZVAL(NP) = 0.0
 1400 CONTINUE
C
C          CALCULATE NEW RIGHT-HAND SIDES
C
        DO 1500 NO=1,NOBJ
        RHS(NO)=RHS(NO)-ZMIN*C(NO,NEVC)
 1500   CONTINUE
        RHS(NOVR)=ZMIN
          DO 1550 NP = 1,NPRT
          DO 1550 NO = 1,NOBJ
        ZVAL(NP)=ZVAL(NP)+RHS(NO)*VALY(NO,NP)
 1550 CONTINUE

C          CALCULATE NEW SUBSTITUTION RATES

      NCOL=NCOL+1
        DO 1601 NC=1,NCOL
          DO 1600 NO=1,NOBJ
          C(NO,NC)=C(NO,NC)-C(NOVR,NC)*(C(NO,NEVC)/
     1              C(NOVR,NEVC))
 1600       CONTINUE
        C(NOVR,NC)=C(NOVR,NC)/C(NOVR,NEVC)
        CALL WRITMX (3,C,NOBJ,NC,-1)
 1601   CONTINUE
      DO 1701 NC=1,NCOL
      CALL SUML (3,L,NLBJ,NC)
          DO 1700 N=1,NOBJ
          IF (ABS(C(N,NC)).LT.ABS(10.**(-5)*C(NO,NC)))
     1      C(N,NC)=0.0
 1700     C(N,NL)=C(N)
      CALL WRITMX (3,C,NOBJ,NL,1)
 1701 CONTINUE
      IF(ITAB.GT.0) CALL RHSC(ITAB)

C          WRITE OUT OF RANGE VALUES FOR JUST OPTIMAL TABLE
```

```
      IF (ITAB.GE.1) CALL PCCLAP(ITAB)
      GO TO 400

C          MOVE TO NEXT LOW R PRIORITY LEVEL

 2100 L1=L1+1
C     L1 IS USED TO DECREMENT PERTOK (REVERSE ORDER)
      GO TO 400

C          WRITE FINAL RESULTS

 2200 WRITE (6,4200) ITER,LEFT
      IF(ITAB.GE.0) CALL PRVLA(ITAB)
      IF(ITAB.EQ.0) CALL PRCOFF(ITAB)
 2600 CALL FINISH(ITAB)
      CALL CLOSMS (3)
 2800 STOP
 3000 WRITE (6,3600) ITER
      CALL FINISH(ITAB)
      STOP

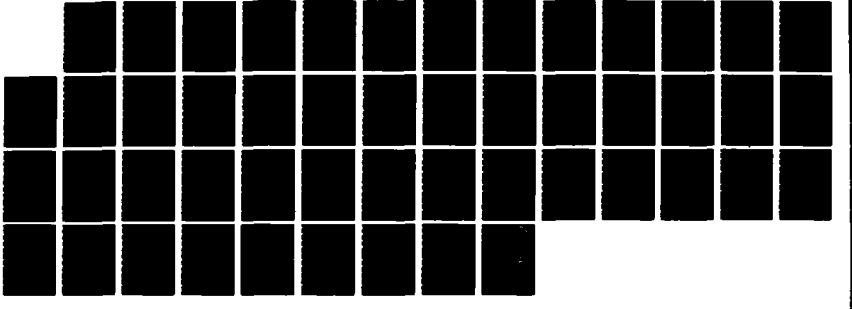
C          FORMAT STATEMENTS

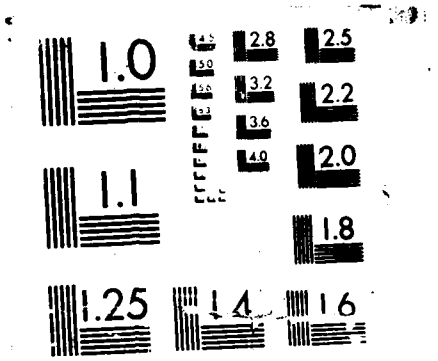

 4100 FORMAT (' NEGATIVE RHS -- ROW ',I4,', VALUE =',F10.2)
 4200 FORMAT (' ERROR ON INPUT FILE  THE PIVOT TEST -- PROGRAM ',
     1        'TERMINATED')
      FORMAT (/' ',I3,' PIVOT ROW = ',A1,I3,', PIVOT COL = ',A1,I3,
     *', PRIORITY ',I4,', PIVOT =',F12.4,
     *', RATIO =',F12.4/)
 4600 FORMAT (' ERROR IN PROBLEM DOES NOT CONTAIN SOLUTION IN ',I3,
     1        ' ITERATIONS -- PROGRAM TERMINATED')
 4700 FORMAT (I3,F12.2)
 4800 FORMAT (I5,' ROW ',I3,10F11.4/(I5,10F11.4))
 4900 FORMAT (I5,' COL ',I3,10F11.4/(I5,10F11.4))
 4100 FORMAT (I1,10F10.4)
 4100 FORMAT (1H1)
 5000 FORMAT (/1H ,'ITERATION.............',T40,I5/
     *10X,'CURRENT FEASIBILITY IMPROVEMENT ',T40,I5/)
      END
```

```
      SUBROUTINE START(ITAB)
C          WITH CHANGES
C     SUBROUTINE START  7 JULY 77    7-7-77    (REVISED 10 JAN 78)
C         REF SANG LEE P. 145
C          THE START SUBROUTINE IS DESIGNED TO TAKE INFORMATION IN A
C         SPECIFIED FORMAT AND TRANSFORM IT INTO A SERIES OF
C          USABLE MATRICES
C
      COMMON C(130,390),
     1      DEVN(3,200),RHS(130),RHS1(130),
     2      NVLX(15,390),SAVEC(130,130),
     3      VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     4      X2VEC(390),ZVAL(15),IFIX,IMAX,ITER,NCOL,NOBJ,
     5        NPRT,NTAB,NVAR,IDSPT
      INTEGER X2VEC
C
C
C
C
C              MATRICES
C
C
C       C  --  COEFFICIENT MATRIX
C       D  --  STORED COEFFICIENT MATRIX
C       HEADER  --  HEADER
C       IPRI -- LIST OF PRIORITIES ASSOCIATED WITH EACH OBJECTIVE
C       NAMOBJ  --  NAME OF OBJECTIVES
C       NAMPRI  --  NAME OF PRIORITIES
C       NAMVAR  --  NAMES OF VARIABLES
C       RHS  -- PRESENT VALUE OF BASIC VARIABLES
C       RHS1 -- SAVED VALUE OF ORIGINAL GOALS
C       NVLX -- THE INDEX MATRIX, BOTTOM STUB, TI
C       SCENAR  --  SCENARIO HEADER
C       STAR  --  MATRIX TO MARK WHICH DEVIATION VARIABLE IS BEING
C                 MINIMIZED
C       VALX -- THE TOP STUB, T
C       VALY -- THE LEFT SIDE STUB
C       WOUT -- THE WRITE-OUT MATRIX   (IN FINISH AND SUMMARY)
C       X  -- THE VECTOR OF ALL VARIABLES
C             BOTH DECISION AND DEVIATION VARIABLES
C             BOTH BASIC AND NON-BASIC VARIABLES
C       Y  -- THE VECTOR OF BASIC VARIABLE NUMBERS
C       ZVAL -- THE ACHIEVEMENT VALUES
C
C                  SCALARS
C
C       IDIAG -- USED FOR DIAGNOSTICS WRITEOUT (NOT IN THIS VERSION)
C       IFIX -- FIX = 10.**(-IFIX),  IFIX = -LOG(FIX)
C       IMAX  -- MAXIMUM NUMBER OF ITERATIONS
C       ITAB  --  TABLE PRINTOUT SWITCH
C       L1 -- USED TO DETERMINE PRIORITY BEING CHECKED(NPRTCK) DUE
C             TO INVERTED ORDER USED IN COMPUTATIONS
C       MAXCOL  --  MAXIMUM # OF COLUMNS
C       MAXOBJ  --  MAXIMUM # OF OBJECTIVES
C       MAXPRI  --  MAXIMUM # OF PRIORITIES
C       NCOL --  NUMBER OF COLUMNS IN COEFFICIENT MATRIX
C             = NVAR + 2  NOBJ
C       NOW --  NUMBER OF OPERATING VARIABLE ROW
```

AD-A184 396 ARMY TRAINING STUDY: BATTALION TRAINING MODEL SUMMARY 3/3
(U) ARMY TRAINING AND DOCTRINE COMMAND FORT MONROE VA
F J BROWN ET AL 08 AUG 78 SBI-AD-F000 104

UNCLASSIFIED F/G 15/1 NL





MICROCOPY RESOLUTION TEST CHART

```
C       NEVC --   NUMBER OF ENTERING VARIABLE COLUMN
C       NOBJ --   NUMBER OF OBJECTIVES (OR ROWS)
C       NPCKP1 = NPRTCK + 1  -- USED TO INCREMENT BEING CHECKED
C       NPRT --   NUMBER OF PRIORITIES IN THE ACHIEVEMENT FUNCTION
C       NPRTCK --  NUMBER OF PRIORITY BEING CHECKED
C       NROWS --  NUMBER OF OBJECTIVES ( OR ROWS)
C       NTAF --   NUMBER OF TERMS IN THE ACHIEVEMENT FUNCTION
C       NVAR --   NUMBER OF DECISION VARIABLES
C       SUMP --   USED TO COMPUTE NEW INDEX VALUES
C       ZMAX --   LARGEST INDEX VALUE FOR CURRENT PRIORITY BEING CHECKED
C       ZMIN --   LIMITING AMOUNT FOR EACH ENTERING VARIABLE,
C                 THE MINIMUM RATIO
C     LOOPS ARE INCREMENTED AS FOLLOWS
C          NC -- THE NC-TH COLUMN
C     LOOPS ARE INCREMENTED AS FOLLOWS
C          NC -- THE NC-TH COLUMN
C     LOOPS ARE INCREMENTED AS FOLLOWS
C          NC -- THE NC-TH COLUMN
C          NO -- THE NO-TH OBJECTIVE
C          NP -- THE NP-TH PRIORITY
C          NR -- THE NR-TH ROW
C          NT -- THE NT-TH TERM IN THE ACHIEVEMENT FUNCTION
C          NV -- THE NV-TH VARIABLE
C
C     ITAB IS USED TO SELECTIVELY PRINT OUT TABLES
C                -1   --  NONE
C                 0   --  FIRST AND LAST COEFFICIENT AND INDEX MATRICES
C                 1   --  ALSO RHS
C                 2   --  ALL
C
C     ***** SUBROUTINE START *****
C
      MAXCOL=390
      MAXOBJ=130
      MAXPRI=15
C
C
C
C       DATA INPUT SECTION I
C       READ THE PROBLEM CARD FOR THE NUMBER OF ROWS, PRIORITIES,
C       VARIABLES,TERMS IN THE ACHIEVEMENT FUNCTION,SWITCHES AND
C       FIXES, MAXIMUM NUMBER OF ITERATIONS
C.....
      READ (5,3300)                    NROW,NPRT,NVAR,NTAF,
     1    ITAB,IDIAG,IFIX,IMAX,IDSPT
      IF(EOF(5).NE.0) GO TO 2600
      NOBJ=NROW
      IF (NVAR.LE.0) GO TO 2400
      IF (NPRT.LE.0) GO TO 2400
      IF (NROW.LE.0) GO TO 2400
C
C       TEST FOR SIZE
C
      NCOL=NVAR+NROW+NVAR
      IF (NROW.GT.MAXOBJ) GO TO 2500
      IF (NCOL.GT.MAXCOL) GO TO 2500
```

```
      IF (NPRT.GT.MAXPRT) GO TO 2500
C
C
      DO 800 NR=1,NROW
      J=NR+NROW
      C(NR,NR)=1.0
  800 C(NR,J)=-1.0
C        READ THE DATA MATRIX IN
C          SECTION III DATA INPUT
C
C          SECTION III DATA INPUT
C
C          SECTION III DATA INPUT
C
C.....
  900 READ (5,3400) IALFA,IROW,JCOL,VALUE
C     **** CHECK FORMAT
      IF (IALFA.GE.99999) GO TO 1100
      IF (IROW.LE.0) GO TO 2800
      IF (JCOL.LE.0) GO TO 2800
      J=JCOL+2*NROW
      C(IROW,J)=VALUE
      SAVEC(IROW,JCOL)=VALUE
      GO TO 900
C
C          READ THE RIGHT HAND SIDE
C       SECTION IV DATA INPUT
C
C.....
 1100 READ (5,3500) IBRAVO,IROW,XRHS
      IF (IBRAVO.GE.99999) GO TO 1200
      RHS(IROW)=XRHS
      GO TO 1100
 1200 CONTINUE
C
C          WRITE OUT THE PROBLEM PARAMETERS
C
      WRITE (6,4400)
      WRITE (6,4500) NROW,NVAR,NCOL,NPRT,NTAF,ITAB,IDIAG,
     1       IFIX,IMAX
C
C
C          READ (AND WRITE OUT) THE OBJECTIVE FUNCTION
C          (THE PRIORITY STRUCTURE)
C          SECTION V DATA INPUT
C
C.....
      WRITE (6,1200)
 1200 FORMAT(10X,*PRIORITY STRUCTURE*//4X,*SIGN*,3X,*ROW*,
     *     PRIORITY      WEIGHT*/)
      IPOSW=18
      ICT=NTAF+1
      DO 1300 NT=1,ICT
      READ (5,3200)           KPRI,LROW,WT
      IF (DF(5).LE.0) GO TO 1700
      IF (KPRI.GT.99999) GO TO 1700
      PRIOR(1,NT)=KPRI
```

```
      OFUN(2,NT)=LROW
      OFUN(3,NT)=100.*WT
      OSGN = 3HPOS
      IF (LROW) 1300,2800,1400
C
C     "0 -- NEG, =0 -- ERROR,  >0 -- POS
C
 1300 KCOL=-LROW
      OSGN = 3HNEG
      LROW = - LROW
      GO TO 1500
 1400 KCOL=LROW+NROW
 1500 K2PRI=NPRT+1-KPRI
      VALX(K2PRI,KCOL)=WT
      WRITE(6,1606) OSGN,LROW,KPRI,WT
      IPRTSW=IPRTSW+1
      IF(IPRTSW.EQ.56.OR.IPRTSW.EQ.112) WRITE(6,3800)
 1606 FORMAT(5X,A3,3X,2I8,6X,F8.2)
 1600 CONTINUE
 1700 CONTINUE
C
C     EVALUATE THE ACHIEVEMENT FUNCTION
C
      DO 1720 NP = 1,NPRT
      ZVAL(NP) = 0.0
      DO 1720 NO = 1,NOBJ
      ZVAL(NP) = ZVAL(NP) + RHS(NO)* VALX(NP,NO)
      VALY(NO,NP) = VALX(NP,NO)
 1720 CONTINUE
C
C
C
C           WRITE THE ABOVE INPUT
C
C.....
C
C              RHS  AND ACHIEVEMENT FUNCTION
C     IF(ITAB.GE.0) WRITE (6,3600)
      DO 2000 NR=1,NROW
      NO = NR
      NO2 =  NO + NOBJ
      X1VEC(NO) = 1HN
      X1VEC(NO2) = 1HP
      X2VEC(NO) = NO
      X2VEC(NO2) = NO
      Y(NR) = NR
      IF (RHS(NR)) 2700,1800,1900
 1800 RHS(NR)=.00001
 1900 RHS1(NR)=RHS(NR)
 2000 CONTINUE
      DO 20 NV = 1,NVAR
      NV2 = NV + 2 * NOBJ
      X1VEC(NV2) = 1HX
   20 X2VEC(NV2) = NV
C
C                    SUBSTITUTION RATES
C
```

```
      IF (ITAB.GE.0) CALL PCOEFF(ITAB)
C
C              RHS, OBJECTIVES AND ACHIEVEMENT FUNCTION
C
      IF(ITAB.GE.0) CALL PRHS(ITAB)
C
C         PARAMETERS
C
      RETURN
C
C        ERROR AND DIAGNOSTICS
C
C.....
 2400 WRITE (6,4700)
      GO TO 2900
 2500 WRITE (6,4800)
      GO TO 2900
 2600 WRITE (6,4900)
      GO TO 2900
 2700 WRITE (6,5000)
      GO TO 2900
 2800 WRITE (6,4600)
 2900 STOP
C
C       FORMAT STATEMENTS
C
C.....
 3200 FORMAT (2I5,F10.0)
 3300 FORMAT (9I5)
 3400 FORMAT (I5,I3,2X,I3,7X,F16.0)
 3500 FORMAT (I5,I3,2X,F16.0)
 3600 FORMAT (//38X,*THE RIGHT HAND SIDE-INPUT AND ACHIEVEMENT-*,
     *COMPUTED*,33X,*PAGE 01*/I5,*VARIABLE*,T20,*AMOUNT*,
     *T40,*ACHIEVEMENT*,T60,*VALUE*/)
 3700 FORMAT (I5,A1,'=',I3,T15,F15.5,T40,I5,T50,F15.5)
 3800 FORMAT(1H1,*PRIORITY STRUCTURE*/4X,*SIGN*,9X*ROW*,
     **    PRIORITY      WEIGHT*/)
 3900 FORMAT (//55X,*THE SUBSTITUTION RATES-INPUT*,18X,
     1         *PAGE 02*/)
 4000 FORMAT (* ROW*,I5)
 4100 FORMAT (10F12.3)
 4200 FORMAT (//55X,*THE OBJECTIVE FUNCTION - INPUT*,19X,
     1         *PAGE 03*/)
 4300 FORMAT (* PRIORITY*,I5)
 4400 FORMAT (1H1,61X,*GOAL PROGRAMMING*/
     *55X, SUMMARY OF INPUT INFORMATION */)
 4500 FORMAT (I10,*NUMBER OF ROWS.....*,T40,I5/I10,
     1         *NUMBER *,*OF DECISION VARIABLES....*,T40,I5/
     2         T10,*TOTAL *,*NUMBER OF COLUMNS....*,T40,I5/
     3         T10,*NUMBER *,*OF PRIORITIES...*,T40,I5/T10,
     4         *NUMBER OF TERMS*/T17,*IN*,* ACHIEVEMENT *,
     5         *FUNCTION*,I5/T10,*WRITE-OUT SWITCH .....*,T40,I5/
     6         I10,*DIAGNOSTIC SWITCH .....*,I40,I5/I10,
     7         *-LOG(FIX) .....',T40,I5/T10,*MAXIMUM NUMBER OF *,
     8         *ITERATIONS .....*,T40,I5/)
 4600 FORMAT (*  PROGRAM CONTAINS AN INPUT ERROR*)
```

```
 4700 FORMAT (* NUMBER OF ROWS, VARIABLES, OR PRIORITIES *,
     1        *CANNOT BE',* EQUAL TO ZERO UNDER ANY *,
     2        *CIRCUMSTANCES.*)
 4800 FORMAT (*  THE NUMBER OF VARIABLES  NEEDED TO *,
     1        *COMPUTE THIS PROGRAM*,* IS TOO GREAT UNDER *,
     2        *PRESENT DIMENSION.*)
 4900 FORMAT (*  PROBLEM CARD MISSING OR MISPUNCHED*)
 5000 FORMAT (*  NEGATIVE VALUES ARE NOT ALLOWED ON THE *,
     1        *RIGHT HAND*,* SIDE.  CORRECT PROBLEM BY *,
     2        *MULTIPLYING ENTIRE CONSTRAINT BY*,* MINUS *,
     3        *ONE.*)
      END
```

```
      SUBROUTINE FINISH(ITAB)
C     SUBROUTINE FINISH   REVISED 16 JAN 78      REF. SANG LEE  P.155
C                WITH CHANGES
C      S/R CALLED BY MAIN PROG  -- GOAL PROGRAMMING
      REAL NGOEV
      COMMON WOUT(130,6),IIPRI(260,2),STAR(130,2),IWT(260,2),
     1       HEADER(12),NAMOBJ(130,2),NAMPRI(15,2),NAMVAR(260,2),
     2       SCENAR(12),QSET(15,12),IDUM(47606),
     3     OFUN(3,260),RHS(130),RHS1(130),
     4     RVLX(15,390),SAVEC(130,130),
     5     VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     6     X2VEC(390),ZVAL(15),IFIX,IMAX,IIER,NCOL,NOBJ,
     7       NPRT,NTAB,NVAR,IOPT
      INTEGER X2VEC
C
C
C                  MATRICES
C
C     C  --  COEFFICIENT MATRIX
C     D  --  STORED COEFFICIENT MATRIX
C     HEADER  --   HEADER
C     IIPRI -- LIST OF PRIORITIES ASSOCIATED WITH EACH OBJECTIVE
C     IWT -- LIST OF WEIGHTS ASSOCIATED WITH EACH OBJECTIVE
C     NAMOBJ  --  NAME OF OBJECTIVES
C     NAMPRI  --  NAME OF PRIORITES
C     NAMVAR  --  NAMES OF VARIABLES
C     RHS  -- PRESENT VALUE OF BASIC VARIABLES
C     RHS1 -- SAVED VALUE OF ORIGINAL GOALS
C     RVLX -- THE INDEX MATRIX, BOTTOM STUB, TI
C     SCENAR  --  SCENARIO HEADER
C     STAR  --  MATRIX TO MARK WHICH DEVIATION VARIABLE IS BEING
C               MINIMIZED
C     VALX -- THE TOP STUB, TI
C     VALY -- THE LEFT STUB, TI
C     WOUT -- THE WRITE-OUT MATRIX   (IN FINISH AND SUMMARY)
C     X  -- THE VECTOR OF ALL VARIABLES
C           BOTH DECISION AND DEVIATION VARIABLES
C           BOTH BASIC AND NON-BASIC VARIABLES
C     Y  -- THE VECTOR OF BASIC VARIABLE NUMBERS
C     ZVAL -- THE ACHIEVEMENT VALUES
C
C                  SCALARS
C
C     IDIAG -- USED FOR DIAGNOSTICS WRITEOUT (NOT IN THIS VERSION)
C     IFIX -- FIX = 10.**(-IFIX),  IFIX = -LOG(FIX)
C     IMAX  -- MAXIMUM NUMBER OF ITERATIONS
C     ITAB  --  TABLE PRINTOUT SWITCH
C     I1 -- USED TO DECREMENT PRIORITY BEING CHECKED(NPRTCK) DUE
C           TO INVERTED ORDER USED IN COMPUTATIONS
C     MAXCOL  --  MAXIMUM # OF COLUMNS
C     MAXOBJ  --  MAXIMUM # OF OBJECTIVES
C     MAXPRT  --  MAXIMUM # OF PRIORITIES
C     NCOL  --   NUMBER OF COLUMNS IN COEFFICIENT MATRIX
C           = NVAR + 2 * NOBJ
C     NLVR  --   NUMBER OF OPERATING VARIABLE ROW
```

```
C     NEVC --   NUMBER OF ENTERING VARIABLE COLUMN
C     NOBJ --   NUMBER OF OBJECTIVES (OR ROWS)
C     NPCKP1 = NPRICK + 1  -- USED TO INCREMENT BEING CHECKED
C     NPRT --   NUMBER OF PRIORITIES IN THE ACHIEVEMENT FUNCTION
C     NPRICK --  NUMBER OF PRIORITY BEING CHECKED
C     NROWS --  NUMBER OF OBJECTIVES ( OR ROWS)
C     NTAB --   NUMBER OF TERMS IN THE ACHIEVEMENT FUNCTION
C     NVAR --   NUMBER OF DECISION VARIABLES
C     SUMP --   USED TO COMPUTE NEW INDEX VALUES
C     ZMAX --   LARGEST INDEX VALUE FOR CURRENT PRIORITY BEING CHECKED
C     ZMIN --   LIMITING AMOUNT FOR EACH ENTERING VARIABLE,
C               THE MINIMUM RATIO
C
C    LOOPS ARE INCREMENTED AS FOLLOWS
C         NC  -- THE NC-TH COLUMN
C         NO  -- THE NO-TH OBJECTIVE
C         NP  -- THE NP-TH PRIORITY
C         NR  -- THE NR-TH ROW
C         NT  -- THE NT-TH TERM IN THE ACHIEVEMENT FUNCTION
C         NV  -- THE NV-TH VARIABLE
C
C
C     ITAB IS USED TO SELECTIVELY PRINT OUT TABLES
C               -1   --  NONE
C                0   --  FIRST AND LAST COEFFICIENT AND INDEX MATRICES
C                1   --  ALSO RHS
C                2   --  ALL
C
C
C
C     *****     SUBROUTINE FINISH      ******
C
C          DEVIATION ANALYSIS
C
C     ......ZERO OUT WOUT ARRAY ............
      DO 5 IO=1,6
      DO 5 NO =1,130
      WOUT(NO,IO)=0.0
    5 CONTINUE
      NROW=NOBJ
      IF (ITAB.GT.0) WRITE (6,2800)
      WRITE (6,2900)
      IF (ITAB.GE.0) WRITE (6,3000)
      WRITE (6,3100)
      IF (ITAB.GE.0) WRITE (6,3000)
      DO 500 NR=1,NROW
      NEGDEV=0.0
      POSDEV=0.0
      WOUT(NR,5)=RHS1(NR)
        DO 100 J=1,2
        STAR(NR,J)=1H
        IIPRI(NR,J)=0
  100   IWT(NR,J)=0
      NROW2=NROW*2
      M=Y(NR)
      IF (M.LT.NROW) GO TO 200
      IF (M.LE.NROW2) GO TO 300
```

```
      NX=M-NROW2
      WOUT(NX,2)=RHS(NR)
      GO TO 500
  200 NEGDEV=RHS(NR)
      WOUT(M,4)=NEGDEV
      GO TO 400
  300 NPOS=M-NROW
      POSDEV=RHS(NR)
      WOUT(NPOS,3)=POSDEV
C 700 WRITE (6,3200) NR,RHS1(NR),POSDEV,NEGDEV
  400 CONTINUE
  500 CONTINUE
      DO 700 NT=I,NTAF
      IPRI=OFUN(1,NT)
      JROW=OFUN(2,NT)
      IF (JROW.GT.0) GO TO 600
C      JROW .NE. 0
      JROW=-JROW
      IWT(JROW,2)=OFUN(3,NT)/100
      STAR(JROW,2)=1H*
      IIPRI(JROW,2)=IPRI
      GO TO 700
C      JROW .GT. 0
  600 IWT(JROW,1)=OFUN(3,NT)/100
      STAR(JROW,1)=1H*
      IIPRI(JROW,1)=IPRI
  700 CONTINUE
      DO 1000 NR=1,NROW
        DO 800 NP=1,NPRT
  800   WOUT(NP,1)=WOUT(NP,1)+VALY(NR,NP)*RHS(NR)
        DO 900 NV=1,NVAR
  900   WOUT(NR,6)=WOUT(NR,6)+SAVEC(NR,NV)*WOUT(NV,2)
      COMP=WOUT(NR,5)+WOUT(NR,3)-WOUT(NR,4)
      IF (ABS(COMP-WOUT(NR,6)).GT.0.1) WRITE (6,1600) NR,
     1    COMP,WOUT(NR,6)
C
 1000 CONTINUE
C
C READ IN HEADERS AND NAMES          DATA INPUT SECTION II
C
      READ (5,3000)(SCENAR(I),I=1,12)
      READ (5,3000)(HEADER(I),I=1,12)
      DO 105 I=1,NPRT
  105 READ (5,3100)(NAMPRI(I,J),J=1,2)
      IF (IDSPT.EQ.0) GO TO 120
      DO 110 I=1,IDSPT
  110 READ (5,3000) (DSPT(I,J),J=1,12)
  120 DO 205 I=1,NVAR
  205 READ (5,3100)(NAMVAR(I,J),J=1,2)
      DO 305 I=1,NOBJ
  305 READ (5,3100)(NAMOBJ(I,J),J=1,2)

C THE OUTPUT ARRAY IS WRITTEN OUT

      DO 306 J=6,7
      WRITE (J,2100)(SCENAR(I),I=1,12),(HEADER(I),I=1,12)
```

```
      WRITE (J,1100) NPRT,NVAR,NOBJ
  306 CONTINUE
      IPRT=MAX0(NPRT,NVAR,NOBJ)
      IPRTSW=15
      DO 1550 I =6,7
      DO 1500 K=1,IPRT
      NK=NPRT+1-K
      IPRTSW=IPRTSW+1
      IF(I.EQ.7) GO TO 1001
      IF(IPRTSW.EQ.56.OR.IPRTSW.EQ.96) WRITE(6,2400)
 1001 IF(IPRTSW.EQ.216.OR.IPRTSW.EQ.279) WRITE(7,2400)
      IF (K.GT.NPRT) GO TO 1200
      IF (K.GT.NVAR) GO TO 1100
      WRITE (I,1800) K,(NAMPRI(K,J),J=1,2),WOUT(NK,1),
     1      (NAMVAR(K,J),J=1,2),WOUT(K,2),(NAMOBJ(K,J),J=
     2      1,2),WOUT(K,3),STAR(K,1),IIPRI(K,1),IWT(K,1),
     3      WOUT(K,4),STAR(K,2),IIPRI(K,2),IWT(K,2),
     4      WOUT(K,5),WOUT(K,6)
      GO TO 1500
 1100 WRITE (I,1900) K,(NAMPRI(K,J),J=1,2),WOUT(NK,1),
     1      (NAMOBJ(K,J),J=1,2),WOUT(K,3),STAR(K,1),
     2      IIPRI(K,1),IWT(K,1),WOUT(K,4),STAR(K,2),
     3      IIPRI(K,2),IWT(K,2),WOUT(K,5),WOUT(K,6)
      GO TO 1500
 1200 IF (K.GT.NVAR) GO TO 1300
      IF (K.GT.NOBJ) GO TO 1400
      WRITE (I,2000) K,(NAMVAR(K,J),J=1,2),WOUT(K,2),
     1      (NAMOBJ(K,J),J=1,2),WOUT(K,3),STAR(K,1),
     2      IIPRI(K,1),IWT(K,1),WOUT(K,4),STAR(K,2),
     3      IIPRI(K,2),IWT(K,2),WOUT(K,5),WOUT(K,6)
      GO TO 1500
 1300 WRITE (I,2200) K,(NAMOBJ(K,J),J=1,2),WOUT(K,3),
     1      STAR(K,1),IIPRI(K,1),IWT(K,1),WOUT(K,4),
     2      STAR(K,2),IIPRI(K,2),IWT(K,2),WOUT(K,5),
     3      WOUT(K,6)
      GO TO 1500
 1400 WRITE (I,2300) K,(NAMVAR(K,J),J=1,2),WOUT(K,2)
 1500 CONTINUE
 1550 CONTINUE
C     CALL SUMRY(WOUT)
      RETURN
C
C             FORMAT STATEMENTS
C
C.....
C
C
 1600 FORMAT (*  S/R  FINISH  -- DIFFERENCE NOTED IN *,
     1       *OBJECTIVE*,* ;*,I3,*, VALUE IN GP SOLUTION*,
     2       F10.2,*, COMPUTED*,F10.2)
 1700 FORMAT (T13,I6,* PRIORITIES*,T35,I6,* DECISION *,
     1       *VARIABLES*,T61,I6,* OBJECTIVES*//T13,*------*,
     2       *----*,*------------*,T39,*------------------*,
     3       *----*,T65,*--------------------------------*,
     4       *---*,*-------------------------------*//T80,
     5       *POSITIVE*,T098, NEGATIVE*/* SUBSCRIPT*,T75,
```

```
     6         *DEVIATION PRI WT*,T94,*DEVIATION PRI WT*,
     7         T116,*GOAL ,T124,*COMPUTED*/)
1800 FORMAT (I6,T12,2A6,F11.2,T38,2A6,F11.2,T63,2A6,
    1         2(F11.2,A1,I2,I4),2F12.2)
1900 FORMAT (I6,T12,2A6,F11.2,T63,2A6,2(F11.2,A1,I2,I4),
    1         2F12.2)
2000 FORMAT (I6,T38,2A6,F11.2,T63,2A6,2(F11.2,A1,I2,I4),
    1         2F12.2)
2100 FORMAT (1H1/T58,*GOAL PROGRAMMING*//20X,12A6//
    1         25X,12A6//)
2200 FORMAT (I6,T63,2A6,2(F11.2,A1,I2,I4),2F12.2)
2300 FORMAT (I6,T38,2A6,F11.2)
2400 FORMAT(1H1/* SUBSCRIPT*,T25,*DEVIATION PRI WT*,T94,
    *         *DEVIATION PRI WT*,T116,*GOAL*,T124,*COMPUTED*/)
3000 FORMAT (12A6)
3100 FORMAT (2A6)
3200 FORMAT (F10.2)
     END
```

```
      SUBROUTINE PCOEFF(ITAB)
C     SUBROUTINE PCOEFF(ITAB)                    14 NOV 1977
C      PURPOSE IS TO WRITE OUT THE COEFFICIENT MATRIX, TITLE, THE
C        ROWS AND COLUMNS, AND PARTITION THE OUTPUT IF THE NUMBER OF
C        COLUMNS IS GREATER THAN 10.
C
C     COMMON
C
      COMMON C(130,390),
     1     OFUN(3,260),RHS(130),RHS1(130),
     2     RVLX(15,390),SAVEC(130,130),
     3     VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     4     X2VEC(390),ZVAL(15),IFIX,IMAX,ITER,NCOL,NOBJ,
     5       NPRT,NTAF,NVAR,IOSPT
      INTEGER X2VEC
      NXX = NCOL
      NROW = NOBJ
      NST = 1
      NFIN = NXX
      ICTR = 1
      NCK = 0
      WRITE(6,900)
  100 IF(NXX.GT.10) GO TO 400
      IF(ICTR.GT.1.AND.NROW.GT.10) WRITE(6,900)
      WRITE(6,1000) ICTR,ITER
      WRITE(6,1100)(X1VEC(J),J=NST,NFIN)
      WRITE(6,1150)(X2VEC(J),J=NST,NFIN)
      WRITE(6,1160)
      DO 200 NR = 1,NROW
  200 WRITE(6,1200) NR,(C(NR,J),J=NST,NFIN)
      IF(NCK.LE.0) RETURN
      ICTR = ICTR + 1
      NST = NST + 10
      NXX = NSAVE
      NFIN = NST + NXX - 1
      NCK = 0
      GO TO 100
  400 NCK = 1
      NFIN = ICTR * 10
      NSAVE = NXX - 10
      NXX = 10
      GO TO 100
  900  FORMAT(1H1)
 1000 FORMAT(/20X,*COEFFICIENT MATRIX -- PARTITION :*,I5,*, ITERATION*,
     **  :*,I5//T20,*VARIABLE*/2X,*OBJECTIVE*/)
 1100 FORMAT(10(11X,A1))
 1150 FORMAT(T3,10I12)
 1160 FORMAT(/)
 1200 FORMAT(I5,10F12.4)
      END
```

```
      SUBROUTINE PRHS(ITAB)
C SUBROUTINE PRHS -- PRINT OUT RHS AND ACHIEVEMENT FUNCTION  3 JAN
C                 TITLE THE ROWS AND COLUMNS, AND PARTITION IF THE
C                 NUMBER OF COLUMNS IS GREATER THAN 10.
C
C       COMMON
C
      COMMON C(130,390),
     1      OFUN(3,260),RHS(130),RHS1(130),
     2      RVLX(15,390),SAVEC(130,130),
     3      VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     4      X2VEC(390),ZVAL(15),IFIX,IMAX,ITER,NCOL,NOBJ,
     5        NPRT,NTAF,NVAR,IDSPT
      INTEGER X2VEC
C
C
C               WOUT MATRIX
C
C       WOUT(NR,1) =  BASIC VARIABLE VALUE
C       WOUT(NR,2) =  VALUE OF THE GOAL
C       WOUT(NR,3) =  VALUE OF THE POSITIVE DEVIATION
C       WOUT(NR,4) =  VALUE OF THE NEGATIVE DEVIATION
C       WOUT(NR,5) =  ACHIEVED VALUE OF THE GOAL
C       WOUT(NR,6) =  COMPUTED VALUE OF THE GOAL
C       WOUT(NR,7) =  VALUE OF THE ACHIEVEMENT FUNCTION
C
C       DELTA  --  CHANGE IN EACH ACHIEVEMENT VALJE
C       KEEP   --  STORES ACHIEVEMENT VALUES
C
C
C       DIMENSION
C
      DIMENSION WOUT(130,7),VAR(130),XVECT(260),IBVAR(130),
     *          DELTA(15),KEEP(15)
C
C       ZERO WOUT MATRIX  AND SET INITIAL PARAMETERS
C
C
C       NN COUNTS THE NUMBER OF OBSERVATIONS
C       NOVAR IS THE NUMBER OF VARIABLES FOR TEST
C            INCLUDING DEPENDENT AND INDEPENDENT VARIABLES
C       NOVAR IS THE NUMBER OF VARIABLES FOR TEST
C            INCLUDING DEPENDENT AND INDEPENDENT VARIABLES
C            OR THREE GROUPS FOR CORRELATION AND REGRESSION
C                 1 -- THE GP VARIABLES  -- THE X'S
C                 2 -- THE RESULTANT OBJECTIVE VALJES -- THE B'S
C                 3 -- THE RESULTANT ACHIEVEMENT VALJES -- THE A'S
C
      REAL KEEP
      DATA NN/0/
      DATA KEEP/15*0.0/
      NN = NN + 1
      NOVAR = NVAR + NOBJ + NPRT
      NMAX = NOBJ
      IF(NOBJ.LT.NPRT) NMAX = NPRT
      NOBJ2=2*NOBJ
      DO 100 N=1,NMAX
```

```
      DO 100 J=1,7
      WOUT(N,J)=0.0
  100 CONTINUE
      DO 120 NV =1,NVAR
  120 XVECT(NV) = 0.0
C
C           COMPUTE WOUT
C
      DO 130 NO=1,NOBJ
      WOUT(NO,2)=RHS1(NO)
      WOUT(NO,5)=RHS1(NO)
      WOUT(NO,1)=RHS(NO)
  130 CONTINUE
      DO 131 I=6,7
      WRITE (I,600) ITER
  131 CONTINUE
      DO 200 NO=1,NOBJ
      M = Y(NO)
      IF (M.LE.NOBJ) GO TO 160
      IF (M.LE.NOBJ2) GO TO 150
C
C     'X' -- DECISION VARIABLE
C
      ISUB=M-NOBJ2
      VAR(NO)=1HX
      XVECT(ISUB)=RHS(NO)
      IBVAR(NO)=ISUB
      GO TO 200
C
C     'P' -- POSITIVE DEVIATION VARIABLE
C
  150 ISUB=M-NOBJ
      VAR(NO) = 1HP
      IBVAR(NO)=ISUB
      WOUT(ISUB,3)=RHS(NO)
      WOUT(ISUB,5)=WOUT(ISUB,5)+WOUT(ISUB,3)
      GO TO 200
C
C     'N' -- NEGATIVE DEVIATION VARIABLE
C
  160 ISUB=M
      IBVAR(NO) = ISUB
      VAR(NO) = 1HN
      WOUT(ISUB,4)=RHS(NO)
      WOUT(ISUB,5)=WOUT(ISUB,5)-WOUT(ISUB,4)
  200 CONTINUE
C
C     COMPUTE WOUT(NO,6) -- COMPUTED OBJECTIVE VALUES
C
      DO 300 NV=1,NVAR
        DO 300 NO=1,NOBJ
  300   WOUT(NO,6)=WOUT(NO,6)+SAVEC(NO,NV)*XVECT(NV)
C
C     COMPUTE ACHIEVEMENT  WOUT(NO,7)
        DO 450 NP=1,NPRT
      DO 400 NO=1,NOBJ
  400 WOUT(NP,7) = WOUT(NP,7) + RHS(NO) * VALY(NO,NP)
```

```
      DELTA(NP) = WOUT(NP,7) - KEEP(NP)
  450 KEEP(NP) = WOUT(NP,7)
C
C     WRITE OUT RESULTS
C
      DO 701 I= 6,7
      DO 700 N=1,NMAX
      NPP = NPRT + 1 - N
      IF (N.GT.NPRT) GO TO 500
      IF (N.GT.NOBJ) GO TO 600
      WRITE (I,900)   VAR(N),IBVAR(N),(WOUT(N,J),J=1,6),N,
     1       WOUT(NPP,7),DELTA(NPP)
      GO TO 700
  500 WRITE (I,900)   VAR(N),IBVAR(N),(WOUT(N,J),J=1,6)
      GO TO 700
  600 WRITE (I,1000) N,WOUT(NPP,7),DELTA(NPP)
  700 CONTINUE
  701 CONTINUE
      RETURN
C
C
C
C        FORMAT STATEMENTS
C
C
  800 FORMAT (1H1/T20,* RIGHT-HAND SIDE, OBJECTIVES AND *,
     1       *ACHIEVEMENT FUNCTION*,* --  ITERATION ;*,I4//
     2       T8,*BASIC VARIABLES*,T60,*OBJECTIVES*,T106,
     3       *ACHIEVEMENT FUNCTION*//T5,*VARIABLE*,T18,
     4       *VALUE*,T39,*GOAL*,T50,*POS-DEV*,T51,*NEG-DEV*
     5       ,T72,*ACHVD*,T82,*COMPUTED*,T104,*;*,T113,
     6       *VALUE*,T125,*DELTA*/)
  900 FORMAT (T5,A1,* -*,I3,T12,F12.3,T35,5F11.2,T100,I5,2F13.3)
 1000 FORMAT (T100,I5,2F13.3)
      END
```

```
      SUBROUTINE PRVLX (ITAB)
C     SUBROUTINE PRVLX (ITAB)                    14 NOV 1977
C      PRINT OUT OF RVLX -- INDEX MATRIX
      INTEGER X2VEC
C
C     COMMON
C
      COMMON C(130,390),
     1      OFUN(3,260),RHS(130),RHS1(130),
     2      RVLX(15,390),SAVEC(130,130),
     3      VALX(15,390),VALY(130,15),Y(130),X1VEC(390),
     4      X2VEC(390),ZVAL(15),IFIX,IMAX,ITER,NCOL,NOBJ,
     5        NPRT,NTAF,NVAR,IDSPT
      NXX = NCOL
      NROW = NOBJ
      NST = 1
      NFIN = NXX
      ICTR = 1
      NCK = 0
      WRITE(6,900)
  100 IF(NXX.GT.10) GO TO 400
      IF(ICTR.GT.1.AND.NROW.GT.10) WRITE(6,900)
      WRITE (6,1000) ICTR,ITER
      WRITE(6,1100)(X1VEC(J),J=NST,NFIN)
      WRITE(6,1150)(X2VEC(J),J=NST,NFIN)
      WRITE(6,1160)
      DO 200 NP = 1,NPRT
      NPP = NPRT + 1 - NP
  200 WRITE(6,1200) NP,(RVLX(NPP,J),J=NST,NFIN)
      IF(NCK.LE.0) RETURN
      ICTR = ICTR + 1
      NST = NST + 10
      NXX = NSAVE
      NFIN = NST + NXX - 1
      NCK = 0
      GO TO 100
  400 NCK = 1
      NFIN = ICTR * 10
      NSAVE = NXX - 10
      NXX = 10
      GO TO 100
  900 FORMAT(1H1)
 1000 FORMAT(/20X,*INDEX MATRIX -- PARTITION ;*,I5,*, ITERATION ;*,
     *I5//T20,*VARIABLE*/2X,*PRIORITY*/)
 1100 FORMAT(10(11X,A1))
 1150 FORMAT(T3,10I12)
 1160 FORMAT(/)
 1200 FORMAT(I5,10F12.4)
      END
```

```
      SUBROUTINE DETERM(M,NROW,VAR,ISUB)
C     SUBROUTINE DETERM          9 NOV 77  (REVISED 3 JAN 78)
C     S/R DETERM  --  DETERMINE WHICH VARIABLE
C           NOVR  -- FROM Y
C           MEVC  -- DIRECTLY
C           M  IS THE INPUT NUMBER OF THE VARIABLE, CODED TO
C              INCLUDE NEGATIVE AND POSITIVE DEVIATION VARIABLES
C              AS WELL AS THE DECISION VARIABLES, IN THAT ORDER
C           VAR IS THE OUTPUT VARIABLE DESCRIPTION
C              VAR = X FOR DECISION VARIABLE
C                  = P FOR POSITIVE DEVIATION VARIABLE
C                  = N FOR NEGATIVE DEVIATION VARIABLE
C           ISUB IS THE VARIABLE INTEGER SUBSCRIPT
C
      NROW2 = 2 * NROW
      IF(M.LE.NROW) GO TO 300
      IF(M.LE.NROW2) GO TO 200
  100 VAR = 1HX
      ISUB = M - NROW2
      GO TO 900
  200 VAR=1HP
      ISUB = M - NROW
      GO TO 900
  300 VAR= 1HN
      ISUB = M
  900 RETURN
      END
```

ANNEX O

COMMON COSTING METHODOLOGY

Introduction

The purpose of this annex is twofold. First, it describes a common costing methodology for use at battalion level which will enhance continued developments of the first generation Battalion Training Model (BTM). The methodology focuses on the resources which are directly related to the training activities of a Mechanized Infantry or Armor battalion. These resources include the battalion's Program 2 Mission funds, training ammunition costs, and training time. Although the Mechanized Infantry and Tank battalions are used as the vehicle for discussion, this methodology is applicable to other type battalions. The conceptual framework for the methodology is discussed in the Resource Cost of Training concept paper. The second purpose of this annex is to address the manner in which BTM outputs could be used for resource justification to senior management as well as for resource allocation at different levels of command. Conclusions and recommendations are included in chapter V to this Volume.

Basis for Resource Costs

The basis for the battalion's resource costs is the training program recommended for an average Mechanized Infantry battalion which is formulated in terms of specific battle drills, training drills, and ARTEP missions and discussed in the concept paper on Unit Training Programs and in Chapter II of this volume. This formulation systematically integrates an average battalion's training of individual and collective tasks into the three categories listed above. Battle drills, embracing realistic time, distance, and condition factors, are conducted under field conditions together with ARTEP mission training. Training drills, on the other hand, are taught in garrison as a prelude to battle drill training. A detailed description of battle and training drills, to include the specific individual and collective tasks contained in each, is found in Annex E of this volume.

Associated with each of the specific training drills, battle drills, and ARTEP missions are frequencies of repetition, and the expected amount of time required for execution as well as ammunition requirements. These requirements recommended for each drill/mission could provide the basis for the justification of Army-wide training ammunition requirements. Under the forthcoming training ammunition mangement information system (TAMIS), ceilings on ammunition expenditures will be established at different levels of command. The ammunition identified for the drills and missions could also serve as a guide for establishing the specific value for those ceilings.

The frequency and time duration recommended for each drill and mission are dependent upon the level of training readiness (e.g., Bn-1, Bn-10, etc.)

to be maintained as well as the following three unit personnel conditions: percent quarterly turbulence, percent officer/NCO fill, and percent of unit strength not present for training. Thus, a unique descriptive training program, expressed in terms of frequencies and time durations of drills/missions, could be recommended for all Mechanized Infantry battalions with like readiness levels and personnel conditions.

The recommended program serves to justify and prescribe resource requirements to senior management as well act as a guide for allocation of training resources by the different levels of command. (How this could be accomplished is addressed later in this annex). The Program 2 Mission costs associated with a specific recommended program are established by the BTM, using historical, and installation/ division-unique cost factors as described in Chapters 2 and 3. The BTM cost output associated with the training recommended for a battalion could serve as a P2 Mission cost ceiling much in the manner as that described above for Class V expenditures. A battalion could be programmed Program 2 Mission funds in accordance with the dollar ceiling established for the unit's training.

Although the recommended program is prescriptive for resource justification and allocation, it is totally descriptive once resources are allocated and the program is executed. In other words, provisions of the program are not mandatory; the local commander can make adjustments based on his own judgment. Accordingly, retention of the prerogative to adjust the frequencies, times, and ammunition recommended for the drills/missions as well as addition or deletion of any individual and/or collective tasks associated with this training remains with the commander. As a general rule, the commander would be able to make any adjustments to the recommended program he considered desirable as long as he does not exceed the dollar ceilings allocated for Program 2 Mission and ammunition and provided he still meets his assigned readiness level.

To determine whether the cost of his adjusted program is within the established dollar ceilings, the battalion commander must have a methodology for estimating his training costs. The methodology used should be identical to that used to develop dollar ceilings associated with the recommended program. Without a common costing methodology, the comparability of the cost figures between various organizational levels and locations cannot be ensured.

Time, the dominant resource at unit level, also needs requires incorporation into this methodology. Just as a commander's proposed training program should not exceed the allocated dollar ceiling, his program also should not exceed a viable time ceiling. To establish such a ceiling, the following methodology is proposed:

Type Training Days

Different type training days are established to facilitate the collection of both time and cost data. Only two days are the most basic,

training activites which have similar equipment usage requirements.

The drills/missions for the different organizational echelons of the battalion are grouped into the type training days displayed in Table 1. The drills/missions are virtually mutually exclusive with respect to different type days; in other words, a specific drill or mission is tied to only one of the type days. Based on the training program definitions outlined in Chapter II, garrison days apply to all training drills but do not apply to battle drills and ARTEP missions.

Battalion Level FTX*	Scout Platoon Field Training
Small Unit FTX	Redeye Team Field Training
Tactical Exercises Without Troops	GSR Team Field Training
Command Post Exercise	Mission Training
Heavy Mortar Platoon Field Training	Multiechelon ARTEP
Antiarmor Platoon Field Training	Garrison Training

* Line Company and below

Table 1. Mechanized Infantry Battalion Type Training Days

The total number of each type day is derived by adding the times and frequencies of all the drills and missions assigned to each of the days and applying hours per type day factors at battalion level. Each type field training day and garrison training day consists of ten and eight hours of training respectively. For example, 160 hours of garrison training drills equates to 20 garrison training days. It should be noted that this total training time requirement is less than the sum of all training days in that many of the training days are scheduled concurrently. For example, the training time requirement for one line company is not influenced by the requirements of any of the other line companies or by any of the combat support platoons. Thus, training time requirements should be determined for different "training units" within the battalion as displayed in Table 2. At times it is useful to refer to the battalion's training time requirement as that of the "pacing training unit" i.e., the training unit in the battalion with the greatest training time requirement.

Line Companies	Battalion Headquarters
Small Unit FTX	Battalion Level FTX
Battalion Level FTX	Multiechelon ARTEP
Multiechelon ARTEP	Tactical Exercise Without Troops
Mission Training	Command Post Exercise
Garrison Training	Mission Training
Heavy Mortar Platoon	**Other Platoons/Teams**
Platoon Field Training	Platoon/Team Field Training
Battalion Level FTX	Battalion Level FTX
Multiechelon ARTEP	Multiechelon ARTEP
Mission Training	Mission Training
Garrison Training	Garrison Training

Table 2. Type Training Days By Training Unit

Other training units within the battalion which must be addressed are the antiarmor and scout platoons and the Redeye and ground surveillance teams. Their training time requirements are determined using the same type days shown for the heavy mortar platoon except their unique type training days replace those of the mortar platoon unique days.

Days allocated for the "command post exercise" and "tactical exercise without troops" are excluded from the line companies' time requirements because this type training involves only a limited number of key company personnel and could be scheduled either during a low priority training period or when the majority of the company is involved in garrison training. Thus, these two exercises generally do not compete for scheduled unit time and are not included as a company requirement per se.

Commander's Development of Requirements

The following discussion addresses how the battalion commander could tailor the descriptive training requirements recommended for an average battalion to meet his specific needs. The tailoring is primarily based on professional judgment and diagnostic ARTEP results. Adjustments to the frequencies, time durations, or Class IV requirements associated with all the recommended drills and missions prior to aggregating them into type

training days can be made. For example, the commander could increase the recommended annual frequency of the company fire and maneuver battle drill from 4 to 5 for each of his three companies. He could leave unchanged the recommended time duration of the drill and the ammunition requirements which are identified by cost per repetition and by number of type rounds by type weapon.

Time Data

After reviewing the recommended drills and missions for desired adjustments, the battalion commander could then aggregate this training into type training days. For example, if conduct of the company fire and maneuver battle drill required 1 1/2 days, and there was a requirement of 5 repetitions per company the total requirement could be expressed as 7.5 small unit FTX days for each company. A notional formulation of a battalion's training program appears in Table 3.

Battalion Headquarters	Days
Battalion Level FTX	26
Multiechelon ARTEP	6
Tactical Exercise Without Troops	6
Command Post Exercise	4
Mission Training	8
	50

A Company	Days
Small Unit FTX	18
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	21
	82

B Company	
Small Unit FTX	18
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	20
	80

C Company	
Small Unit FTX	17
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	21
	80

Heavy Mortar Platoon	
Platoon Field Training	15
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	24
	81

Antiarmor Platoon	
Platoon Field Training	13
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	18
	73

Scout Platoon	
Platoon Field Training	12
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	25
	79

REDEYE Team	
Team Field Training	14
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	18
	74

GSR Team	
Platoon/Team Field Training	11
Battalion Level FTX	26
Multiechelon ARTEP	6
Mission Training	10
Garrison Training	19
	72



Table 3. Training Time Requirements (Notional)

After an estimation of time requirements is made, a determination of whether the program as planned can be executed within the available resevoir of training time is required. If necessary, training time resources can be transferred among training units. For example, if the line companies have high requirements, training time could be transferred from the combat support platoons to the line companies which may have lower requirements. This is accomplished by assigning to the combat support platoons a disproportionate share of non-training tasks, thus, releasing additional training time for the line companies. Situations may exist where an imbalance of training time requirements and training time resources is so great that a cross-leveling of training time resources within the battalion cannot totally compensate for the shortfall in available training time. This becomes a problem for the immediate local chain of command.

Dollar Data

The determination of dollar costs using the battle drill-type training days concept is explained below. Central to the explanation is an understanding of the dollar costs associated with training. The majority of these costs are incurred for supply, Classes III (petroleum products), V (ammunition), and IX (spare parts) attributable to field training. Expenses such as the cost of computer time for computer assisted war games used in command post exercises, batteries for the M70 TOW trainer, etc. are categorized as "other costs".

Thus, for the purpose of the following discussion, the types of cost are categorized as Class III/IX, Class V, and others. The Classes III and IX costs are consolidated because they are both dependent on equipment usage rates. The three cost categories are addressed separately below.

Class III/IX Costs

The Class III/IX costs, which are dependent upon equipment usage rates, are based upon the number of the different type training days scheduled in the battalion's adjusted training program. As noted earlier, the different type training days embrace training activities which have generally similar equipment usage requirements. Thus, equipment requirements would be relatively similar for different small unit FTX days, while there would be significant differences between the average equipment requirements for a small unit FTX day and battalion level FTX day.

The cost of each of the different type days could be computed by applying equipment cost factors to the equipment usage rate associated with each type training day.* Installation/ division unique cost factors and equipment usage rates should be used to ensure reliability of cost estimates The equipment usage data should be based on the equipment identified as cost sensitive in the FORSCOM training management control system (TMCS).

* $\frac{\$}{\text{mile}} \times \frac{\text{mile}}{\text{FTX day}} \times \text{FTX days} = \$$

Equipment usage data for the garrison training day is treated in a different manner. Generally, garrison training does not involve equipment which generates significant costs; however, there may be isolated training drills which do. Recall that all training drill activities are limited to garrison training days. If there are training drill sensitive costs, it would be inappropriate to associate these with all garrison training days. The average cost per garrison day would be inflated resulting in grossly inaccurate estimates of garrison training day costs. Thus, for the purpose of identifying Class III/IX costs related to garrison training, it is necessary to review all the training drills to identify any having significant cost-sensitive equipment usage. Any that are so identified are further examined to determine the practicality of grouping them into subsets of garrison days having similar equipment usage requirements. The subsets would then be treated separately (as are types of field training days) for estimating class III/IX costs of garrison training.

Historical data relating to equipment usage rates should be used to estimate costs of an adjusted program for comparison with the established dollar ceiling; however, actual usage data should be used to record costs during program execution. For the program comparison, a continuously adjusted average, rate of equipment utilization is used for each type day. This adjusted average rate could be computed from historical data from the previous three to five years. During the execution cycle, actual usage data should be collected at the completion of any logical sequence of a given type training day. The usage data for that particular sequence of days could be used to compute a revised cost for those specific days. The revised cost could be compared with the planned cost and if necessary, t e unexecuted portion of the program could be adjusted accordingly. Additionally, the actual usage data which should be collected could feed the data base for updating the aforementioned adjusted average.

The Class III/IX cost estimate related to the battalion's proposed field training program, as identified in Table 3, would be based on an average factor which lays out cost per type field training day. The factor would be a function of the multiyear average of equipment usage by type training day and appropriate, equipment operating cost factors (e.g., cost per mile). The training days of a common type would be grouped together to facilitate the computational effort as shown in Table 4. For example, Company A's, B's, and C's small unit FTX day requirements of 18, 18, and 17 days , respectively, would be listed as 53 small unit FTX days.

Type Field Training Day	Number of Days		Cost/day	Cost
Battalion Level FTX	26	X	$5,700 =	$148,200
Small Unit FTX	53	X	920 =	48,760
Tactical Exercise Without Troops	6	X	300 =	1,800
Command Post Exercise	4	X	520 =	2,080
Heavy Mortar Platoon Field Training	15	X	280 =	4,200
Antiarmor Platoon Field Training	13	X	120 =	1,560
Scout Platoon Field Training	12	X	350 =	4,200
Redeye Team Field Training	14	X	110 =	1,540
GSR Team Field Training	11	X	180 =	1,980
Mission Training	10	X	400 =	4,000
Multiechelon ARTEP	6	X	7,000 =	42,000
				$260,320

Table 4. Field Training Day Cost Estimate (Cost/day based on actual data; all other columns are notional)

Class V Costs

The battalion commander should estimate the cost of Class V requirements for his proposed training program to determine if it falls within his allocations. The estimated Class V cost of the proposed program should be based on the training activities planned in the program. The Class V cost estimate for a battalion's proposed training program could be developed in the same manner as the Class III/IX costs of garrison training. These costs should be based on the training activity itself not the type of training days because Class V varies drastically from training event to training event. Although an average ammunition cost per small unit FTX day could be computed, use of average costs would produce unacceptable results. For example, cost estimates would be grossly overstated for those days dedicated to battle

drills having no ammunition requirements. Therefore, Class V costs should be computed on a training activity rather than training day basis.

When developing the cost estimates, drills and missions having similar requirements should be grouped together. The cost for each drill and mission or group of drills and missions should be estimated using a three to five year moving average technique.

During the execution of the training program, actual ammunition expenditures should be recorded. The collection of the actual expenditure data should be a relatively simple matter once the automated, training ammunition management information system is fully implemented. This should be used by the battalion commander for two primary purposes.

First, he should match his actual expenditures against his projections. If the recheck reveals an imbalance, the battalion commander may have to make adjustments to his training plan by reducing consumption in some future drills. Alternatively, he could appeal to brigade or division to increase his ammunition dollar ceiling. On the other hand if his expenditures were lower than planned, he could reduce his Class V requirement. This action could permit a cross-leveling of ammunition allocations within the brigade or division.

The second use for the actual expenditure data would be to update the historical data base on class V consumption. Since the data base should serve as the information source for computing the training ammunition projections mentioned earlier, the effect would be an update of the consumption factors. Additionally, the data base could be used by institutional trainers to validate the ammunition requirements associated with each drill or mission.

It should be noted that cross-leveling Class V dollars with other elements of expense is not feasible. While the "other than Class V" dollars are budget dollars, those associated with the Class V are not. The Class V dollar ceiling is a management tool to control the expenditure of training ammunition. The dollar figure acts as a common denominator which provides local commanders the flexibility to make constrained adjustments to their ammunition allocations. The actual budget dollars related to the ammunition were in a procurement budget several years prior, and funds cannot be transferred from ammunition to some other category.

Consider the adjustments to the recommended program in the example. It was noted that the commander increased the company fire and maneuver battle drills from 3 to 4 for each of his three companies. This change would have the following impact. Each drill is related to a notional Class V cost of $19,098. Therefore, the commander would either have to reduce ammunition related to other drills by $57,294 (3 X $19,098) or, he could request an additional allowance from brigade/division. For the this discussion, assume the commander decremented other drills to

accommodate the adjustment to the company fire and maneuver drill, thus remaining within his allocated ceiling of $526,000.

Other Costs

The other costs are those which fall outside the categories of Class III/IX or Class V. This set of "other costs" consists of two distinct subsets. One subset , while training induced, cannot be tied to any specific drill or mission. This subset of costs would be relatively stable over a wide range of training alternatives. That is, the total cost would not be affected significantly by adjustments to the training program. This subset of costs could be related to the total (training and non-training dependent) Class II/IV costs incurred by the battalion. This total cost has historically been estimated on an authorized or assigned man-day strength basis. Thus, the value of the training related portion would remain constant over a wide range of training alternatives. For the example assume the training related portion of these relatively fixed costs to be $34,000.

The second subset of "other costs" are attributable to a limited number of specific training drills. A detailed review of each of the training drills should be made to identify significant dollar costs. The resulting cost factors would be installation/division dependent to enhance the reliability of cost estimates.

Some other costs identified with particular training drills are a combination of fixed and variable costs. The fixed portion of the cost is not affected by the number of repetitions of the particular drill. On the other hand, the variable portion of the cost varies with changes in frequency. The training drill cost associated with moving target simulator (MTS) training Redeye teams is an example of such a mixed cost. A cost can be related to each repetition of an MTS training drill. Additionally, there is a cost which remains stable (fixed) over a wide range of repetitions of MTS training drills. An example of the fixed cost is the cost of augmentation personnel dedicated to the operation of the MTS. The combined fixed and variable cost of a given number of frequencies of the MTS training drill should be computed as $Y = b + a X$ where Y is the total cost, b is fixed cost, a is the variable cost, and X is the frequency of repetition. Any "other costs" found to be a mix of fixed and variable costs should be computed in the same manner. For the example used in this discussion assume the total fixed portion of this subset of "other costs" to be $21,000, while the variable portion is $30,000.

Analysis of the Commander's Adjusted Program

The battalion commander's analysis of his adjusted program should address both time and dollar requirements. The detailed time data should be reviewed to determine if the program is executable within the amount

of training time available to the battalion. The same data should be used by training managers at brigade and division for allocating time among the units under their managerial control. Since the data is related to training area requirements, the data is of value in scheduling training facilities and areas.

The dollar data can be summarized in a number of ways depending upon its intended use. The Table 5 is one useful means of making cost comparisons by category of training.

Field Training	=	$260,320 (See Table 4)
Garrison Training	=	51,000 (See Page 11)
Unrelated Training	=	34,000 (See Page 10)
Total Training Cost	=	$345,320

Table 5. Cost of Training by General Category (Notional)

To address the impact of increments and decrements to a battalion's training allocation, a display of fixed and variable costs should be useful. Such a display appears in Table 6.

Fixed Costs		
Unrelated to Training Activity	=	$34,000
Fixed Portion of Garrison Training	=	21,000
		55,000
Variable Costs		
Field Training	=	$260,320
Varible Portion of Garrison Training	=	30,000
		290,320
Total Cost:	=	$345,320

Table 6. Fixed and Variable Costs (Notional)

The battalion commander's analysis of his adjusted training program ing program should include a comparison of his adjusted ammunition

requirements with the Class V ceiling allocated by higher headquarters. In the example, the adjusted requirement was equal to the established ceiling. If the adjustment caused the cost to exceed the ceiling, the commander could request an additional allocation or reduce his requirements by readjusting the drills/missions. On the other hand, any unneeded portion of his Class V allocation should be identified to allow cross-leveling within the brigade/division.

Summary

Through use of BTM outputs, a training program could be developed which is tailored to a battalion training readiness level and personnel conditions. The program would be a combination of training drills, battle drills, and ARTEP missions grouped into a set of training days. Additionally, the BTM could estimate the cost to conduct the training identified in the recommended program.

The program should be prescriptive for justifying resource requirements; however, it must be descriptive for execution by the battalion commander. He must be free to make adjustments to the recommended program as long as he does not exceed the dollar ceilngs established for Class V and Program 2 Mission funds and meets his readiness standard. Thus, the battalion commander should estimate the cost of his desired program to ensure it can be executed within the imposed dollar constraints. Additionally, the commander must determine whether his adjusted program can be accommodated within the time allocated for training.

Resource Justification/Allocation

The second stated purpose of this annex is to address the manner in which the BTM outputs can be used for resource justification and as a guide for resource allocation at different levels of command. The discussion will focus on rolling up the BTM developed field training programs for managerial use at echelons from battalion through DA. The numbers used in the following examples are strictly notional and should not be interpreted as a reflection of any actual situation.

The BTM is designed to establish precise training resource requirements for type battalions in terms of drills and missions. The requirements are tailored for the training readiness requirement (e. g., Bn-5) of the battalion as well as its personnel conditions. The mix of drills and missions is aggregated into a fixed set of type training days. By applying installation/division dependent, cost/type day factors, the BTM estimates the resource requirements. The notional training program for a Mechanized Infantry battalion with a training readiness level of Bn-5 and with specified levels of turbulence, officer/NCO fill, and not present for training strength is displayed in Table 7.

The battalion level FTX cost/day is used as a common denominator to convert the total cost related to each type day into a $ battalion field training day ($BFTD) which should be used as the medium of exchange for making adjustments to the recommended program. In this example, the battalion has been funded for 68.8 $BFTDs @ $5,700 per day. The battalion commander should not be required to allocate those 68.8 $BFTDS in the recommended manner. He should make adjustments to the program as he deems necessary based upon his professional judgement, diagnostic ARTEP results, and other pertinent considerations. Theoretically, he could make adjustments that would result in the purchase of:

1. 68.8 battalion level FTX days

or 2. 426 small unit FTX days

or 3. 56 multiechelon ARTEP days

or 4. Any combination that would cost less than or equal his dollar ceiling of $392K.

NOTIONAL DATA

Type Field Training Day	No. of Days		Cost/Day		Cost	$BFTD
Battalion Level FTX	40	x	$5,700	=	$228,000	40
Small Unit FTX	90	x	920	=	82,800	14.53
Tactical Exercises Without Troops	6	x	300	=	1,800	.32
Command Post Exercise	4	x	520	=	2,080	.36
Heavy Mortar Platoon Field Training	31	x	280	=	8,680	1.52
Antiarmor Platoon Field Training	30	x	120	=	3,600	.63
Scout Platoon Field Training	28	x	350	=	9,800	1.72
REDEYE Team Field Training	22	x	110	=	2,420	.42
GSR Team Field Training	20	x	180	=	3,600	.63
Mission Training	18	x	400	=	7,200	1.26
ARTEP Diagnostic	6	x	7,000	=	42,000	7.37
					$392K	68.8

Table 7. BTM Generated Field Training Requirements for a Particular Mechanized Infantry Battalion (NOTIONAL)

Assume that the BTM determined the requirements for a tank battalion in the same division to be as displayed in Table 8. The battalion would be funded for 69.2 $BFTDs at $7,100 per day for a total ceiling of $491K. The drills/missions related to the number/type of training days are shown in Table 8.

NOTIONAL DATA

Type Field Training Day	No. of Days		Cost/Day		Cost	$BFTD
Battalion Level FTX	42	x	$ 7,100	=	$298,200	42
Small Unit FTX	95	x	1,100	=	104,500	14.72
Tactical Exercise Without Troops	5	x	300	=	1,500	.21
Command Post Exercise	4	x	520	=	2,080	.29
Heavy Mortar Platoon Field Training	39	x	270	=	10,530	1.48
Scout Platoon Field Training	33	x	350	=	11,550	1.63
Redeye Team Field Training	22	x	110	=	2,420	.34
GSR Team Field Training	20	x	180	=	3,600	.51
Mission Training	18	x	500	=	9,000	1.27
Multiechelon ARTFP	6	x	8,000	=	48,000	6.76
					$491K	69.2

Table 8. BTM Generated Field Training Requirements for a Particular Armor Battalion. (NOTIONAL)

As with the Mechanized Infantry battalion, the Armor battalion commander could make adjustments to the program as long as his adjustments did not exceed the ceiling of $491K.

The field training requirements for all Infantry and Armor battalions of the parent Mechanized Infantry division could be expressed as shown in Table 9. The number of $BFTDs required by different battalions of a given

type within the division would be different based on a difference of assigned training readiness levels. For example, the 5th Mechanized Infantry battalion could be assigned a Bn-10 and the 3d battalion assigned a level of Bn-5; thus, the 3d battalion should have to maintain a higher level of sustainment training which would generate a greater requirement for $BFTDs.

Type Battalion	Required Number of $BFTDs	Cost Per $BFTD
1st Mechanized Infantry Battalion	68.8	$5,700
2d Mechanized Infantry Battalion	67.1	5,700
3d Mechanized Infantry Battalion	70.1	5,700
4th Mechanized Infantry Battalion	68.8	5,700
5th Mechanized Infantry Battalion	65.6	5,700
1st Armor Battalion	69.2	7,100
2d Armor Battalion	72.6	7,100
3d Armor Battalion	69.2	7,100
4th Armor Battalion	75.3	7,100

Table 9. Mechanized Infantry Division's Field Training Requirements (Notional)

Even if all battalions of a given type within the division were assigned the same readiness level, the battalions could still have different $BFTD requirements. Training programs adequate to maintain different battalions at a given readiness level are dependent on unit personnel conditions. Thus, the 3d Mechanized Infantry battalion could have a greater $BFTD requirement because its higher level of turbulence required a higher frequency of training.

For communicating a division's requirements to the major command (MACOM), the battalions' requirements can be rolled up into a division requirement. For example, the division's requirements displayed in Table 9 could be expressed as: 626.7 $BFTDs $6,340/day for a total funding requirement of $3,973,278. A recapitulation of a MACOM's requirements might appear as in Table 10.

Unit	Type	Required Number of $BFTDs	Cost per $BFTD	Funding Requirement ($M
Division A	Mech Inf	626.7	$6,340	$3,973
Division B	Mech Inf	650.5	5,500	3,578
Division C	Armor	645.0	7,150	4,612
Division D	Armor	661.5	6,873	4,546

Table 10. MACOM Field Training Requirements
(Notional)

The number of $BFTDs required by similar divisions would probably be different because of different readiness levels, personnel conditions, or a combination of the two. Additionally, the different cost/$BFTD could be caused by the fact that one division has newer equipment than the other which results in a lower cost per mile to operate. A difference in cost/$BFTD could also be caused by the fact one division's training areas are considerably closer to its cantonment area than the other. This could cause a difference is average equipment usage rates which is related to the cost/$BFTD.

The MACOM's requirements might be rolled-up allowing DA to express its requirements as shown in Table 11. In communicating to OSD or the Congress, the Army-wide figures could be used, while the MACOM dependent values would be used for coordination with the MACOMs.

MACOM	Required Number of $BFTD	Cost per $BFTD	Funding Requirement ($M)
MACOM 1	2,583.7	$6,467	$16,711
MACOM 2	3,816.1	7,500	28,619
Army-Wide	6,400.0	7,083	45,330

Table 11. Army-Wide Field Training Requirements. (Notional)

The Army requirement for 6,400 $BFTDs does not reflect a need for all the Army's battalions to spend a total of 6,400 days in the field. It does represent, however, the density of drill/mission training requirements of the Army's battalions tied to a dollar base. Thus, by knowing the cost/$BFTD, a macro assessment of the impact of a funding shortfall could be made. Consider, for example, an OSD proposed $6.8 million cut to the Army's unit training program. Based on the average cost of $7,083/$BFTD

(Table 11), the cut in funds tranlates into a 960 $BFTD reduction in the Army's total requirement for 6400 $BFTDs. DA could split the 960 $BFTD reduction between the two MACOMs based upon a MACOM's percentage of the total $BFTD requirement. Since MACOM 1's requirement for 2,583.7 $BFTDs represents 40% of the Army-wide total of 6,400 $BFTD's, MACOM 1 would lose 388 $BFTD's (or $2,509,196) and MACOM 2 would lose the remaining 572 $BFTDs.

The MACOMs could use the same process to allocate the unfunded $BFTDs to their subordinate commands. Table 12 is a summary of the action taken by MACOM 1. The MACOM's 388 unfunded $BFTDs are distributed proportionally among the divisions according to their percentage of the MACOM's total $BFTD requirement. Thus, for Division A: 24.2% of 388 = 94.1 unfunded $BFTDs (column 5) is the difference betwee the requirement listed in column 2 and the unfunded $BFTDs allocated in column 4.

Unit	Required Number of $BFTDs	% of MACOM Total $BFTD Requirement	Number of Unfunded $BFTDs	Number of Funded $BFTDs
Division A	626.7	24.2	94.1	532.6
Division B	650.5	25.2	97.7	552.8
Division C	645.0	25.0	96.9	548.1
Division D	661.5	25.6	99.3	562.2
	2583.7	100%	388	2195.7

Table 12. MACOM 1's Distribution of Unfunded $BFTDs.
(Notional)

The 388 $BFTD cut to MACOM 1, which equates to $2,509,196, could result in an actual loss of more or less than 388 $BFTDs depending upon the way the cut was applied to the requirements of the four divisions. The actual loss of $BFTDs would be less than 388 if a disproportionate share of the 388 $BFTDs were withdrawn from divisions with cost per $BFTD less than the MACOM average of $6,467. However, the average of 388 would be relatively valid for an initial, macro assessment at DA level until the detailed analysis is formulated by the subordinate commands and consolidated at DA as discussed below.

Continuing with the example, assume MACOM 1 elected to cut its divisions as shown in Table 12. Division A's reduction of 94.1 $BFTDs would result in a funding shortfall of $596,594 (94.1 $BFTDs X $6,340 per $BFTD).

Division A could repeat the process described above with respect to its battalions' requirements displayed in Table 9. As a result of Division A's action, the 1st Armor Battalion would be funded for only 58.8 SBFTDs rather than for its BTM determined requirement for 69.2 SBFTDs. The battalion commander would then have to readjust his proposed training program so that it could be conducted within the funded level of 58.8 SBFTDs. Additionally, the funding shortfall at battalion level could be related to a reduction in specific battle drill activity which in turn would be associated with a reduced level of sustainment training. Thus, while the battalion could be assigned a readiness level of Bn-5; however, a funding shortfall could cause the battalion to be able to only sustain a readiness level of Bn-10. The changes in readiness of all battalions could be determined by the BTM in a similar manner. DA would then be in a position to express the effect of the $6.8 million shortfall in terms of reduced unit readiness. For example, MACOM 1: ten Armor battalions, Bn-5 to Bn-10, five Armor battalions, Bn-1 to Bn-10, twelve Mechanized Infantry battalions Bn-1 to Bn-10. The effect on MACOM 2 could be expressed in a similar manner. Relating resources to readiness in this way should be a useful step toward the justification and allocation of the resource cost of training.

ANNEX P

CONCEPTS ANALYSIS AGENCY COMMENTS

1. This annex consists of the paper prepared by Concepts Analysis Agency (CAA) regarding future direction for the Battalion Training Model. This thoughtful paper, together with the TRASANA paper on the same subject (Annex Q) provides a starting point for future development.

2. The following additional comments are appropriate:

a. Future Development. The apparent commonality between BTM and certain CAA efforts emphasizes the desirability of CAA becoming proponent for the research version of the BTM. (See Chapter V, this volume)

b. Management. Although the need for a single proponent is strong, the argument for spheres of responsibility split along functional lines between CAA and TRASANA is stronger. It appears that proponency and management authority should rest with DA, DCSOPS. CAA could be responsible for the research version and TRASANA seems best oriented to the unit version of the BTM. The DCSOPS role must be one of active management and strong control to maintain commonality.

c. *Focus.* Recommend further study to determine the need for division, corps, and MACOM versions of the model.

Comments on ARTS Directions

1. Future Development

a. Most of ARTS attention seems to have been directed to the battalion level. Next it is necessary to determine how data input to and output from the Battalion Training Model (BTM) can be aggregated and used to prepare management reports. But first you must determine the informational needs of managers at DA, MACOM, and perhaps CORPS level by a research effort. Then two things should be done.

(1) Be sure that inputs required of battalion commanders reflect not only their needs but also the information needed to generate reports to DA, MACOM, etc.

(2) Be sure the BTM will produce outputs which are useful to echelons above battalion. Aggregating and preprocessing the data from all battalion commanders can generate useful management reports on conditions existing or perceived in the field. The BTM could be run for each battalion and the results provided to the unit commander. Also, the results of all BTM runs could again be aggregated to produce consolidated management reports. Figure 1 depicts the process. Also, refinement of the algorithms and testing of the assumptions of the BTM must be undertaken.

b. There is an apparent relationship between the ARTS system and the Readiness System developed at CAA. Recommend discussion with Mr. Gordon Barry, CAA 295-1595 (AUTOVON or commercial). Decisions on interfacing with Readiness, OMNIBUS, or other systems needs to be made prior to final design of BTM.

2. Management

a. A full time staff dedicated to BTM would be required. By way of comparison (admittedly not a good one), it takes about 20 people to maintain, update, provide input, run, and interpret the results of the Concepts Evaluation Model (CEM), a primary theater level combat model.

b. A life cycle management process for the BTM should be established. This would include the typical functions of model development (a continuing project to improve the model), establishing and controlling a production version of BTM (to be updated as required), and operation of the model.

c. The BTM should be controlled so that there is only one production version of the model (i.e., only authorized persons can make changes to it). This will minimize the probability that someone will adjust the model to yield results more (or less) favorable to a special interest.

d. If the BTM is to be an Army-wide model for use in decision making by all echelons from battalion, thru MACOM's to DA, then a proponent should be established carefully. Ideally the model proponent should not be a party with a vested interest in the model results.

3. Focus. The model was conceived as a battalion level model. It should remain that way, otherwise a battalion model, a division model, corps model...(ad nauseum) will result. It is reasonable to assume that with proper thought to input requirements and output reports, the BTM (a single model) could serve the needs for all echelons. (See previous discussion on future development, including Figure 1.)

4. Technology

a. Because of size, complexity, and importance of the model, it is imperative that the final model be designed, constructed, and documented using the latest techniques (i.e., structured design and structured programing). Failure to do so will make maintenance of the model difficult-to-impossible as time goes on and rotation of personnel eliminates the "corporate memory."

b. How to make BTM available to the battalion commander is not clear. Two approaches (at opposite extremes) are described.

(1) Have BTM resident and operating at only one location (say the basement of the Pentagon). Through a world-wide communication system the users are data-linked to the computer center where their inputs are processed and outputs are reported back. An advantage of this approach is that inputs and outputs can be accumulated easily and directly for processing management reports.

(2) Give each battalion commander a minicomputer or microcomputer with the BTM hardwired in it. He can run the model whenever and as many times as he wishes.

c. Project VIABLE, under the auspices of the Army Automation Director (AAD), is pointed toward creation of a multicommand system of small computers interfaced via data communications. ARTS may be able to utilize this environment to obtain distributed processing at the battalion level.

5. Data Control

a. Recommend establishing a Data Administrator. This person would be responsible for, and the focus for acquisition of, all data, updating data on a regular basis, assuring quality of the data, and controlling any automated data bases.

b. Three kinds of data seem to exist.

(1) Input Data for Processing. These are the raw data from the field which are acted upon by BTM and also are the basis for management reports.

(2) Output Data. These results are from BTM processing and are bases for other management reports.

(3) Model Data. These data are used to compute the many coefficients of the algorithms in the BTM. These data probably change over time and need to be updated and analyzed to recompute model coefficients so the BTM is always "current."

c. Any data coming in should be tested and subjected to quality assurance checks. This can avoid senseless data and spot obvious errors, thereby improving the validity of model results.

d. As BTM becomes institutionalized, the need to improve and expand the model will require research and associated data. In many cases, data will not exist, and special projects will be necessary to generate data by designing experiments, conducting tests, and collecting data. These can be both costly and time consuming. If not carefully conceived and executed, they also can be worthless.

6. Data Base Technology

a. The data does not appear to be a major technical problem. While it may be voluminous, it does not have complex relationships, and use of a sophisticated Data Base Management System (DBMS) should be weighed carefully as it may place an unnecessary burden on computer resources. Conventional retrieval methods or a file management system could perhaps suffice.

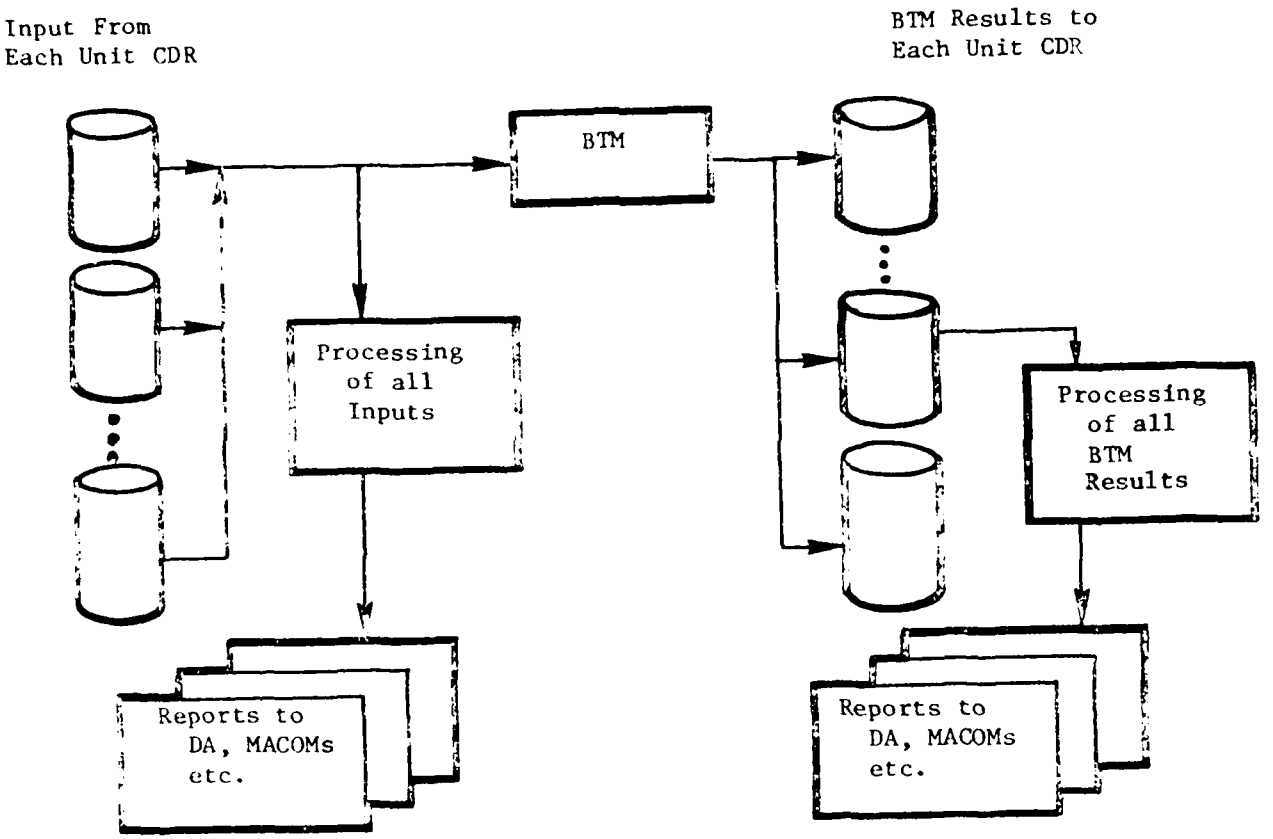
b. The first step in using a data base is to develop a data dictionary. It is advisable to do this before a decision is made on use of a DBMS since it will clarify data relationships, a useful exercise regardless of the final decision.

c. If after the possible alternatives have been considered it is still deemed necessary to use a DBMS, then it is strongly recommended that a CODASYL system be selected. By this is meant a DBMS which conforms to the specifications approved by the Conference on Data Systems Languages; since at least one such DBMS has been developed for use on equipment from each of the major computer manufacturers, this provides for easier transportability of data bases.

d. If it is not possible to define all potential uses at the initial stage, the data is best maintained in source format rather than, or in addition to, a transformed or "rolled-up" state.

e. An audit trail of use of the system could prove very meaningful. Therefore, the system should be designed to capture and store use statistics, as well as changes to the data base itself.

f. A brief bibliography on data base management is provided at Inclosure.



BTM Reporting Process

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ANNEX Q

TRADOC SYSTEMS ANALYSIS ACTIVITY COMMENTS

1. This annex contains the TRADOC Systems Analysis Activity (TRASANA) input and recommendation for future development. This thorough document, together with the CAA input (Annex P) provides a starting point for future development.

2. The following additional comments are appropriate:

a. Life Cycle Management Concept. Input data requirements could become burdensome on units. Every effort must be extended to minimize that burden. In addition, the model must be of significant value to the units to ensure they receive some "payback" for the data effort they put into it.

b. Life Cycle Management Implementation. The potential uses of the BTM apply across the Army to all MACOM's and to DA. To ensure all user needs are satisfied, ARTS believes that DA, DCSOPS should be designated proponent with analytical and modeling responsibility given to CAA and TRASANA. The CAA effort should address the research and major headquarters users of the model. TRASANA is best suited to develop the BTM version for use by field units. This split responsibility can work only through strong and active participation by the proponent.

1. PURPOSE

To recommend follow-on efforts necessary and estimate resources required to bring the ARTS Long-Term Methodology to full fruition.

2. BACKGROUND

Both the ARTS group at Fort Belvoir and TRASANA have been working toward developing a Long-Term Methodology (LTM) that would enable the Army to periodically ask and receive quantitative answers to training--related questions involving programs, resources used, turbulence impacts, training readiness attained, training scheduling, etc. The ARTS group at Fort Belvoir has approached the problem via an adaptation of goal programming techniques. In its present version, this tool is focused on structuring, sizing, formatting, and packaging a battalion level training management tool that would provide a Battalion Commander information and techniques to help him manage his training program and simultaneously create a data base that higher echelons can exploit in managing training. This tool, with minor modifications, could be repackaged to assist in training management up to division level and down to platoon level. The two approaches are complementary and, taken together as the LTM, from the top and bottom of a hierarchy of models/tools and required to provide accurate information on training-related questions and thereby assist the total Army in its training mission.

3. SCOPE

This paper addresses the efforts needed and estimates the resources required to carry forth the development of a long-term methodology for providing the Army with a consistent and meaningful technique to quantify training-related questions on a regular basis. The efforts are addressed in terms of a life-cycle management concept and a life-cycle management implementation that contains the initial steps in a management system for the LTM and a chart contains estimates of resources and time for implementation.

4. LIFE CYCLE MANAGEMENT CONCEPT

The ARTS Study Group has established the existence of a diverse and disparate set of Army elements whose training or training support mission is jeopardized by a lack of training-related information that is timely and appropriately integrated and formatted. Hierarchally, these elements run the gamut from DA staff to unit platoon leaders. Each element requires related but different information about training-related matters, i.e., information specifically integrated and related to its own

environment and goals. This universal, recurring, changing need for timely, specific training-related information is the driving requirement behind the life cycle management concept for the ARTS long-term methodology. The concept envisioned is one that will create and institutionalize a management system that continually oversees and provides for the following activities:

a. Identification of all specific elements of the heirarchy of users of training-related information and provision for a forum in which specific information requirements can be brought forth for further actions.

b. Coordination and integration of information requirements into a hierarchy of models (or different ways of soldierizing/packaging essentially the same model).

c. Orderly development of the models/tools that will satisfy the information requirements ensuring maximal of data transfers between models in either direction in the hierarchy.

d. Recommendation/assignment of responsibilities for the development, maintenance, proliferation, and control of each model/package and its associated data base.

e. Coordination of hardware requirements, ensuring maximal compatibility practicable.

f. Maintenance of a historical/archival file containing records of all appropriate matters related to the management system, i.e.:

- Users
- Information requirements
- Hardware by user/model
- Software developers
- Software documentation
- Software by user/model version
- Recommendations/Decisions

5. LIFE CYCLE MANAGEMENT IMPLEMENTATION

Within the Army, there are a number of major structures and agencies having a vested interest in the development and implementation of the LTM. To assure that each interest is fully considered, it is recommended that an advisory group be established with representation from each interested agency. It appears that TRADOC has a compelling interest in the development and implementation of a LTM by virtue of its overall mission and therefore, it is assumed that TRADOC could be given proponency for the LTM. This implies that the advisory group would be chaired by the DCST, HQ TRADOC. As a first step, the chairman should establish the membership from the major Army structures and agencies having vested interests. The members should then draw up a charter incorporating items a through f under paragraph 4. Execution of the charter should then set in motion the events necessary to fully develop and exploit the ARTS prototype products. The attached chart contains the resources and time estimated to develop, proliferate, and maintain a family of software packages. The chart is constructed under the assumption that the user requirements can be stratified at essentially three levels which will, in turn, dictate the packaging and hardward requirements of the different members of the software family.

LONG-TERM METHODOLOGY
RESOURCE AND TIME ESTIMATES

		MAJOR MODEL BREAKOUT BY USER REQUIREMENT/PACKAGING		
		PLATOON DIVISION	CORPS-THEATER	ARMY-WIDE
DEVELOP	Hardware	$50K Mini-System	Terminal + I/O Peripheral Hookup to time shared net or time shared 3rd generation main frame	Dedicated MIDI (150K) or time share 3rd generation main frame
	Personnel	5	3	3
	Time	12 months for initial battalion level package	12 months	12 months
PROLIFERATE	Hardware	$30K/unit $400K/division	Same as above/unit	Same/user
	Personnel	8 additional	3 (same)	3 (same)
		Given available hardware approx. 3 months/div	1 month/unit	1 month/unit
MAINTAIN		Same as developmental system, no additional cost	Same as top	Same as top
	Personnel	3 of original 5	3 (same)	3 (same)
	Time	Continuous	Continuous	Continuous





ANNEX R

DATA QUALITY LEVEL DESCRIPTIONS

QUALITY LEVEL	TEST RESULTS	SURVEY RESULTS	BATTALION TRAINING MODEL OUTPUT
(QL1)	Multiple valid tests and $\alpha \leq .05$	Unbiased questionnaire, controlled sample, valid analysis.	Relative trend correct, absolute value of data validated by field testing.
(QL2)	Valid test and $\alpha \leq .20$	Biased questionnaire, controlled sample, valid analysis.	Relative trend correct, absolute value of data consistent with professional judgement and/or survey data.
(QL3)	Data collected and trends indicated.	Unbiased questionnaire, small sample, no analysis.	Relative trend correct, absolute value of data unvalidated.
(QL4)	Insights, not directly supported by data.	Biased questionnaire, small sample, no analysis.	Relative trend unvalidated.
(QL5)	Information of marginal validity. Included primarily because no better information exists. Use only with deliberate caution.		
(QL6)	Information judged to be of insufficient quality to include.		

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END

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